

**JOHN HUNTER HEALTH  
INNOVATION PRECINCT PROJECT**

Biodiversity Development Assessment  
Report  
Significant Development Application  
(SSDA)

**FINAL**

August 2021

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Biodiversity Development Assessment Report  
Significant Development Application (SSDA)  
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Significant Development Application (SSDA)

### FINAL

Prepared by  
Umwelt (Australia) Pty Limited  
on behalf of  
Health Infrastructure

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Report No. 4965/R03  
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### Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Shaun Corry	9 March 2021	Allison Riley	9 March 2021
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# Executive Summary



In June 2019, the NSW Government announced a significant expansion of the John Hunter Hospital with the \$780 million John Hunter Health and Innovation Precinct (JHHIP) project (the Project). The aim of the JHHIP is to deliver updated facilities which provide additional capacity to meet the demand of the Greater Newcastle, Hunter New England, and northern NSW Regions.

Approval is being sought for a new Acute Services Building and refurbishment of existing hospital facilities at John Hunter Hospital.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt Environmental and Social Consultants (Australia) Pty Limited (Umwelt) for the Project using the Biodiversity Assessment Method (BAM) in accordance with the *Biodiversity Conservation Act 2016* (BC Act).

The Development Footprint supports three Plant Community Types (PCTs) and 2 species credit species, being:

- PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter
- PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
- PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
- squirrel glider (*Petaurus norfolcensis*)
- black-eyed Susan (*Tetratheca juncea*)

Following the application of avoidance and minimisation measures, the BAM assessment identified the following biodiversity credits required to offset the impacts of the Project:

- PCT 1592 - 69 credits
- PCT 1619 - 13 credits
- PCT 1627 - 35 credits
- Black-eyed Susan (*Tetratheca juncea*) – 11 credits
- Squirrel glider (*Petaurus norfolcensis*) – 132 credits.

Health Infrastructure (HI) is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable removal of biodiversity values as a result of the Project. The biodiversity offset strategy will be developed during the assessment process in consultation with the Biodiversity and Conservation Trust (BCT) and Department of Planning, Industry and Environment (DPIE) and based on the following offset options available under the BC Act and Biodiversity Conservation Regulation using one or more of the following options:

- securing required credits through the open credit market and/or
- payments to the Biodiversity Conservation Fund.

# Glossary of Acronyms

BAM	Biodiversity Assessment Methodology
BAM-C	BAM Calculator
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BCD	NSW Biodiversity Conservation Division (formerly Office of Environment and Heritage) – part of NSW Department of Planning, Industry and Environment
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
CCS	Composition condition score
CEEC	Critically endangered ecological community
DAWE	Commonwealth Department of Agriculture, Water and the Environment (previously Department of the Environment and Energy)
DoEE	(Former) Commonwealth Department of the Environment and Energy (now DAWE)
DNG	Derived Native Grasslands
DPIE	NSW Department of Planning, Industry and Environment
Ecosystem credit	A measurement of the value of threatened ecological communities and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity value at a development site and the gain in biodiversity value at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FCS	Function condition score
GIS	Geographical Information System
HBT	Hollow bearing tree
HI	Health Infrastructure
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
JHHIP	John Hunter Hospital Innovation Precinct
LLS Act	Local Land Services Act 2013
LEP	Local Environment Plan
LGA	Local Government Area
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
NSW	New South Wales
PCT	Plant Community Type
PMST	Protected Matters Search Tool

SCS	Structure condition score
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection database.
SSD	State Significant Development
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VIS	Vegetation Information System

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# 1.0 Introduction

In June 2019, the NSW Government announced a significant expansion of the John Hunter and John Hunter Children's Hospitals with the \$780 million John Hunter Health and Innovation Precinct (JHHIP) project. The JHHIP will transform healthcare services for Newcastle, the greater Hunter region and northern NSW communities. The infrastructure will provide additional inpatient capacity to the John Hunter and John Hunter Children's Hospitals and create further opportunities for partnerships with industry and higher education providers.

The JHHIP will deliver an innovative and integrated precinct with industry-leading facilities working in collaboration with health, education and research partners to meet the current and future needs of the Greater Newcastle, Hunter New England and Northern NSW regions.

The John Hunter Health and Innovation Precinct Project is being planned and designed with ongoing communication and engagement with clinical staff, operational staff, the community and other key stakeholders with a strong focus on the following:

- Patient-centred care
- Contemporary models of care
- Future economic, health and innovation development opportunities
- Environmental sustainability.

## 1.1 Summary of the Project

The John Hunter Health Campus (JHHC) is located on Lookout Road, Lambton Heights, within the City of Newcastle Local Government Area (LGA), approximately 8km west of the Newcastle CBD (**Figure 1.1**). The hospital campus is located approximately 3.5km north of Kotara railway station.

The JHHC comprises the John Hunter Hospital (JHH), John Hunter Children's Hospital (JHCH), Royal Newcastle Centre (RNC), the Rankin Park Rehabilitation Unit and the Nexus Unit (Children & Adolescent Mental Health). JHHC is a Level 6 Principal Referral and tertiary Hospital, providing the clinical hub for medical, surgical, child and maternity services within the Hunter New England Local Health District (HNELHD) and across northern NSW through established referral networks. Other services at the campus include the Hunter Medical Research Institute (HMRI), Newcastle Private Hospital and the HNELHD Headquarters.

Approval is being sought for a new Acute Services Building and refurbishment of existing hospital facilities at John Hunter Hospital comprising:

- Construction and operation of a new seven-storey Acute Services Building (plus 4 semi-basement levels) to provide:
  - an expanded and enhanced Emergency Department;
  - expanded and enhanced medical imaging services;
  - expanded and enhanced intensive care services - Adult, Paediatric and Neonatal;
  - expanded and enhanced Operating Theatres including Interventional Suites;
  - an expanded Clinical Sterilising Department;

- Women's Services including Birthing Unit, Day Assessment Unit and Inpatient Units;
- integrated flexible education and teaching spaces;
- expanded support services;
- associated retail spaces;
- new rooftop helipads;
- new semi-basement car parking;
- Refurbishment of existing buildings to provide:
  - additional Inpatient Units;
  - expanded support services;
- A new Hospital entry canopy and works to the existing drop off;
- Link bridge to the Hunter Medical Research Institute (HMRI);
- Campus wayfinding and signage;
- Landscape works;
- Site preparation including bulk earthworks, tree removal, environmental clearing, cut and fill;
- Mines grouting remediation works;
- Construction of internal roads network and construction access roads and works to existing at-grade carparking;
- Connection to the future Newcastle Inner City Bypass; and
- Inground building services works and utility adjustments.

This Biodiversity Development Assessment Report (BDAR) supersedes the previously exhibited version (May 2021) and has been prepared by Umwelt Environmental and Social Consultants (Umwelt) for the Project using the Biodiversity Assessment Method (OEH 2017a) (BAM) in accordance with the *Biodiversity Conservation Act 2016* (BC Act) within the Savings and Transition period of 12 months from 22 October 2020. The BDAR was prepared and approved by accredited BAM assessor Shaun Corry (BAAS17041) with the final version issued to Health Infrastructure on 13 August 2021, within 14 days of the BAM Calculator being finalised and re-submitted on or before 27 May 2021.

## 1.2 SEARs Requirements

SEARs Requirement	Relevant Report Section
Biodiversity impacts related to the proposed development are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the Biodiversity Conservation Act 2016 (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method.	<b>This Document</b>
The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.	<b>Section 5.0</b>
The BDAR must include details of the measures proposed to address the offset obligation as follows: <ul style="list-style-type: none"> <li>– the total number and classes of biodiversity credits required to be retired for the development/project</li> <li>– the number and classes of like-for-like biodiversity credits proposed to be retired</li> <li>– the number and classes of biodiversity credits proposed to be retired in accordance with the variation rules</li> <li>– any proposal to fund a biodiversity conservation action</li> <li>– any proposal to conduct ecological rehabilitation (if a mining project)</li> <li>– any proposal to make a payment to the Biodiversity Conservation Fund.</li> </ul>	<b>Section 7.3</b>  <b>Section 9.0</b>
If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	<b>NA</b>
The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.	<b>Section 1.7</b>
Consideration of Koala SEPP 2021 (replaced Koala SEPP 2019)	<b>Section 4.2</b>

## 1.3 Description of the Study Area

The Study Area (**Figure 1.2**) is 33 hectares (ha) in size and located approximately 8 km west of Newcastle. The Study Area occurs within the Sydney Basin IBRA Bioregion and Wyong IBRA subregion. It is characterised by remnant bushland vegetation and habitats surrounding the existing John Hunter Hospital.

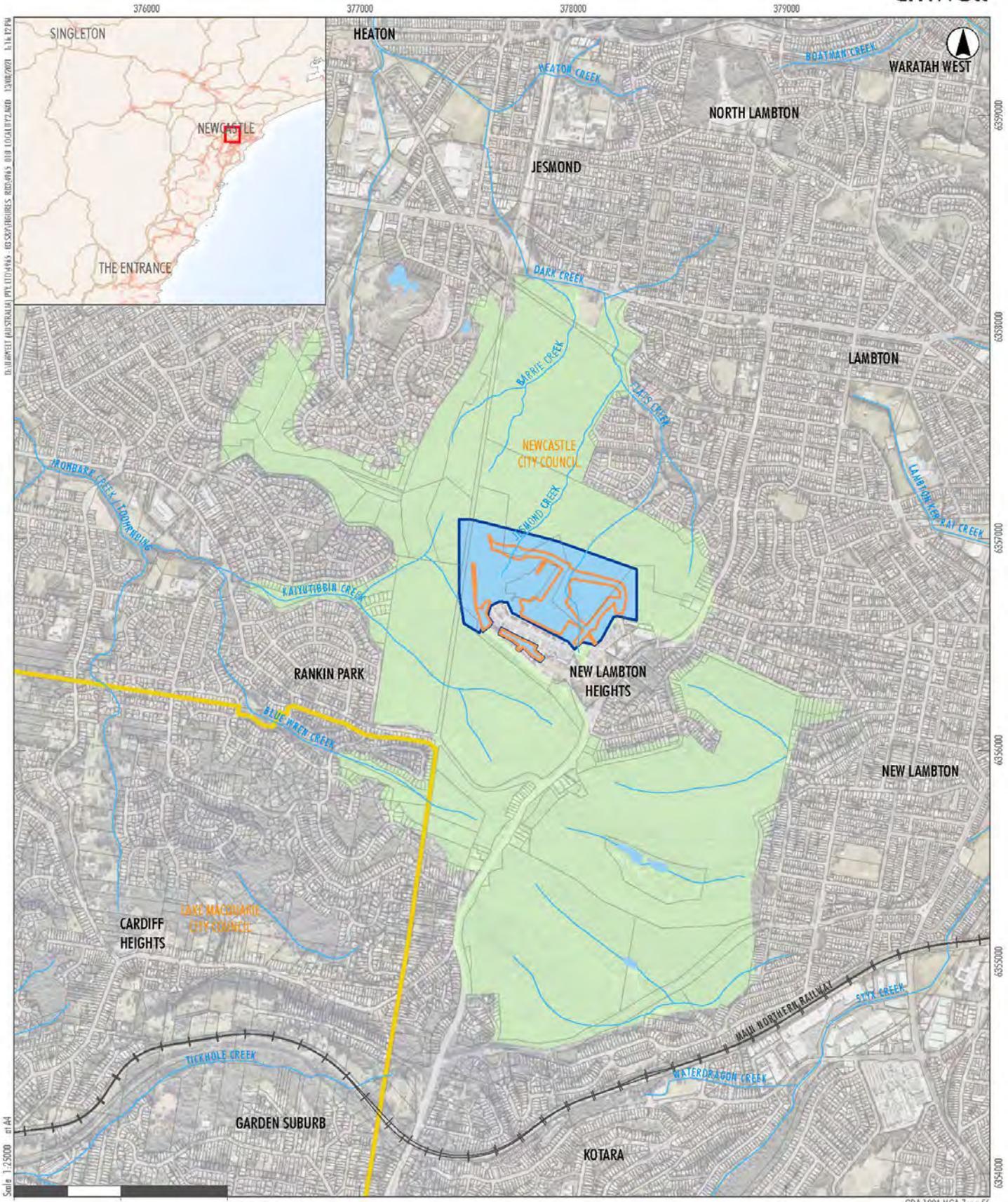
**Table 1.1** provides details for the Study Area.

**Table 1.1 Study Area Details**

Study Area Details	
Name	JHHIP Project
Size	33 ha
Development Footprint	9.4 ha
Lot and DP	1/DP1228246 2/DP1228246 9/DP826092 11/DP826092 41/DP1176191 202/DP1176551
Current Land Use	Existing John Hunter Hospital infrastructure, with patches of the Jesmond Bushland Reserve bushland used for recreational activities.
LGA	Newcastle
LEP Zoning	Newcastle Local Environmental Plan (LEP) 2012
Assessment Type	State Significant Development (SSD)
Assessment ID	00017871

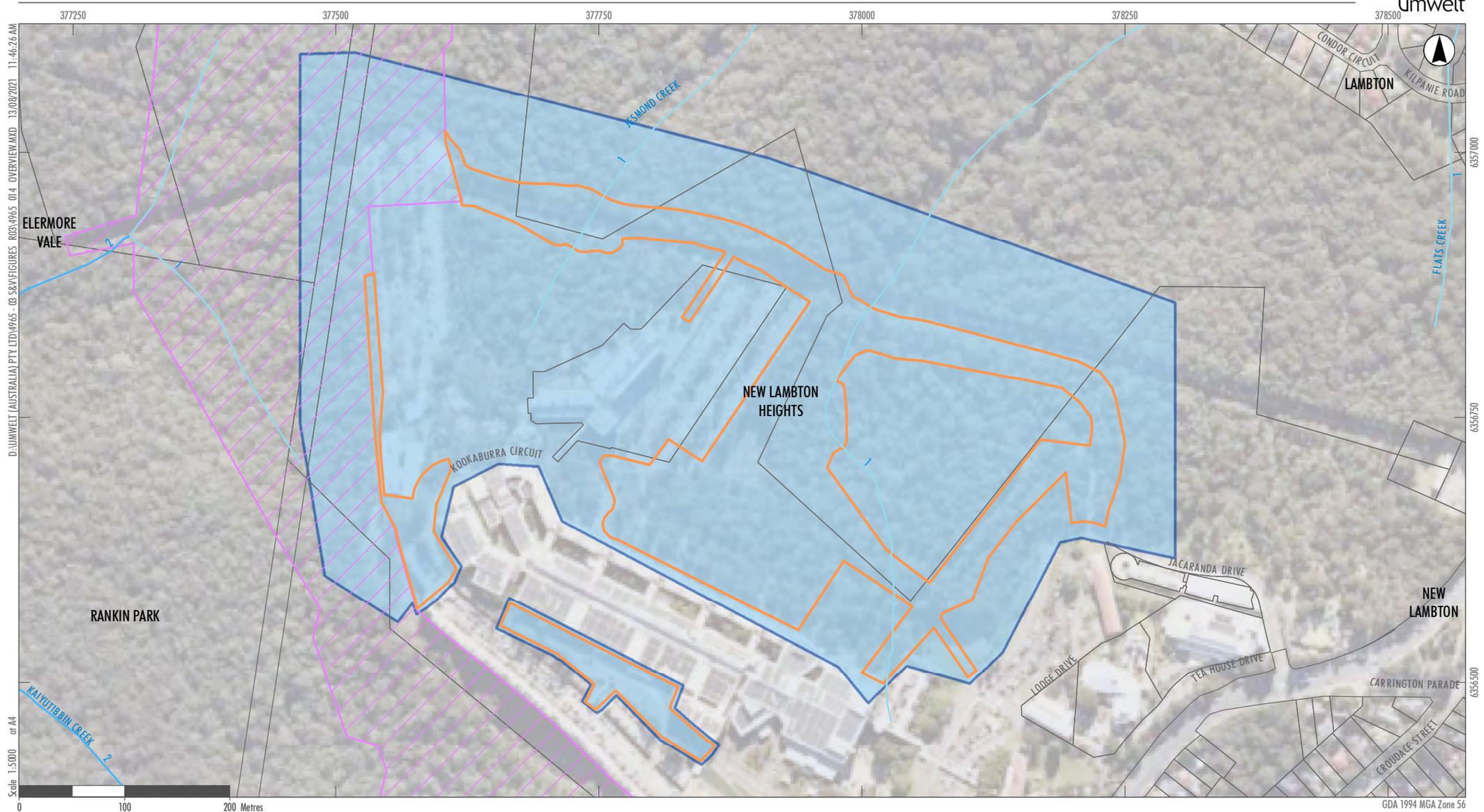
## 1.4 Development Footprint

The Development Footprint (**Figure 1.2**) represents areas which will be subjected to a range of disturbances (outlined in **Section 6.0**) resulting from the Project. This includes access roads and associated batters, bushfire Asset Protection Zones (APZ), Acute Services Building Footprint and other ancillary infrastructure. All areas of direct impact are confined to the Development Footprint. The Development Footprint is approximately 9.4 ha in size.



- Scale 1:25000 at A4
- 0 0.5 1 Kilometers
- Legend**
- Study Area
  - Biodiversity Assessment Area (Development Footprint)
  - Local Government Boundary
  - Parks
  - Cadastre
  - Drainage Line
  - Railway Line

**FIGURE 1.1**  
**Locality Plan**



**FIGURE 1.2**  
**Project Overview**

## 1.5 Key Resources, Policies and Documents

The following key resources, policies and documents were used to prepare the BDAR:

- Biodiversity Assessment Methodology 2017
- Biodiversity Assessment Method Operational Manuals – Stage 1 and Stage 2
- Version 1.2.7.4 BAM Calculator (BAM-C)
- Vegetation Information System (VIS) Classification Database
- Ecological Constraints for a Proposed New Route for State Highway 23 between Rankin Park and Jesmond Report (Umwelt 2006)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Preliminary Environmental Investigation (Parsons Brinckerhoff 2014)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Biodiversity Assessment Report (GHD 2016)
- DPIE Atlas of NSW Wildlife
- Threatened Biodiversity Data Collection (TBDC)
- Department of Agriculture, Water and the Environment (DAWE) Protected Matters Database.

## 1.6 Accredited Assessors

Shaun Corry (Principal Ecologist) was the overseeing Accredited BAM Assessor for this BDAR. **Table 1.2** below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the BDAR.

**Table 1.2 Accredited BAM Assessors and their Role on this Project**

Name	Assessor ID	Role
Allison Riley <i>Principal Ecologist</i>	BAAS17042	Review and technical direction
Shaun Corry <i>Principal Ecologist</i>	BAAS17041	BAM calculator application BDAR preparation
Rhys Osborne <i>Ecologist</i>	BAAS20026	Field Surveys

## 1.7 Interaction with the Rankin Park to Jesmond Bypass

Rankin Park to Jesmond (RP2J) is the fifth and final stage of the Newcastle Inner City Bypass and passes to the west of the John Hunter Hospital. That project was approved in February 2019 and is currently going through a final design process. The Biodiversity Assessment for RP2J (GHD 2018) was based on a construction footprint that overlaps, in part, with areas of the JHHIP (Refer to **Figure 1.2**). As such, those areas assessed for that project have been considered and offset under that approval and have been excluded from the Development Footprint assessed in this BDAR.

## 2.0 Landscape Context

### 2.1 Site Context

The Study Area occurs within the Sydney Basin Bioregion, which extends from north of Batemans Bay to Nelson Bay, and West to Mudgee. It falls within the Gosford-Cooranbong Coastal Slopes Mitchell landscape, which comprises hills and sandstone plateau outliers of Triassic Narrabeen sandstones, with extensive rock outcrop and low cliffs along ridge margins (DECC 2008).

The 1:100,000 Soil Landscape Sheet of the Newcastle Region indicates that the Study Area is characterised mostly by the Killingworth (ki) soil landscape of undulating to rolling hills and low hills on the Newcastle Coal Measures of the Awaba Hills region. Dominant soil materials include brownish black pedal loam (topsoil), bleached hard setting loamy sand to sandy clay loam (topsoil) and pedal yellowish brown clay (subsoil) (DPIE 2020a).

The Study Area encompasses some of the existing John Hunter Hospital infrastructure and facilities, and patches of the Jesmond Bushland Reserve. Vegetation in this area is characterised by open forest and woodland and is currently used for recreational activities such as cycling and bushwalking.

Several first order (Strahler 1952) streams occur within and around the Study Area, including Jesmond Creek, Barrie Creek and Kaiyutibbin Creek. The Hunter Estuary Wetlands (Ramsar) are located approximately 7 km to the north east of the Study Area (DPIE 2012).

**Figure 2.1** provides the Site Map as required by Subsection 3.2.3 of the BAM.

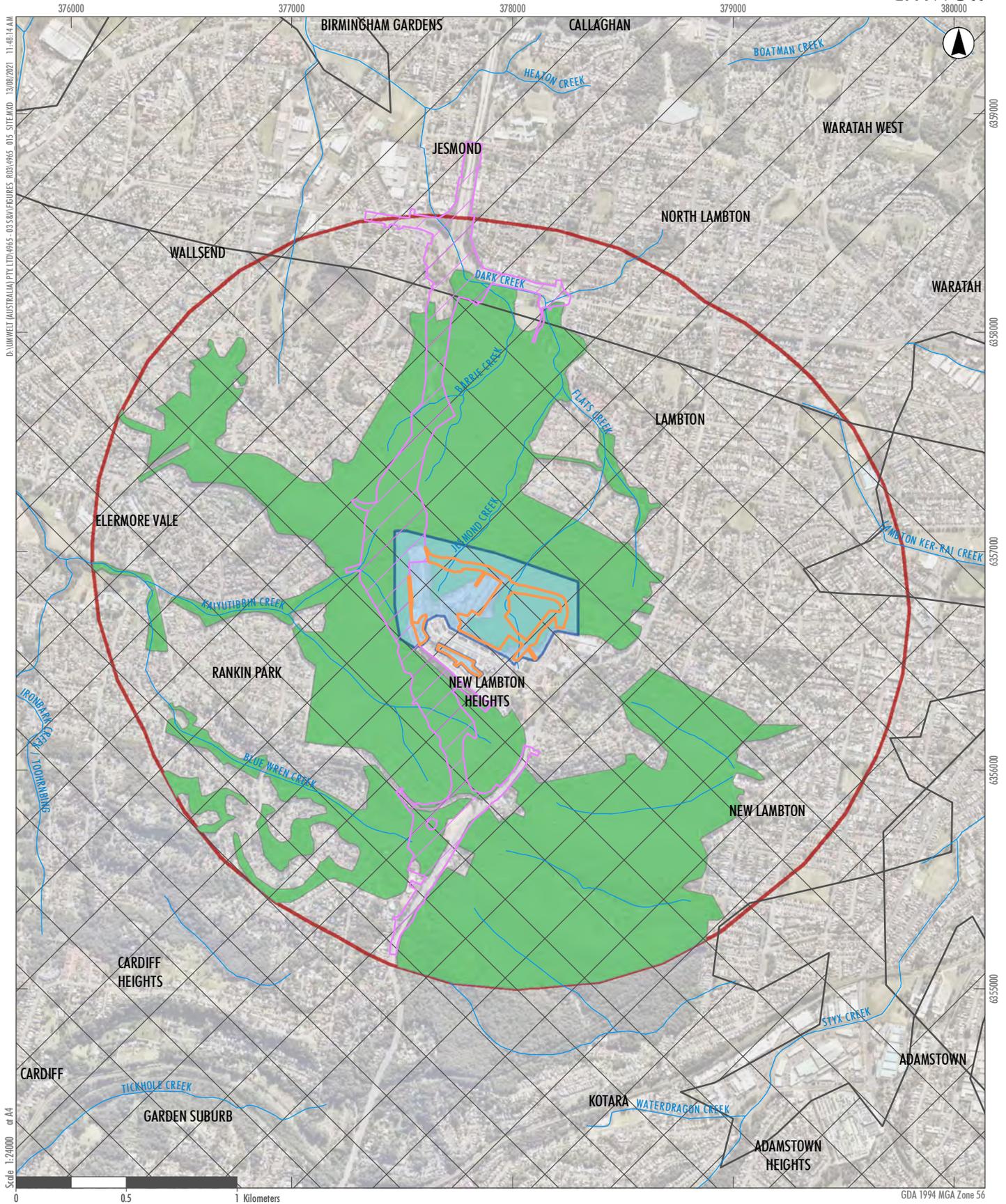
### 2.2 Landscape Features

The Development Footprint (refer to **Figure 1.2**) is 13.5 hectares in size. Refer to **Table 2.1** for a summary of the other relevant landscape features that pertain to the BAM assessment.

Relevant landscape features are shown in **Figure 2.1**.

**Table 2.1 Landscape Features within the Development Footprint**

Landscape Features	
NSW Mitchell Landscape	Gosford - Cooranbong Coastal Slopes
Native Vegetation Cover	38%
Strahler Streams	Jesmond and Flats Creek – 1 <sup>st</sup> Order
Important and Local Wetlands	Nil
Areas of Geological Significance and Soil Hazard Features	Nil
Areas of Outstanding Biodiversity Value	Nil
Connectivity Features	Remnant bushland in Jesmond Bushland Reserve provides movement corridor for fauna to nearby Reserves including Blackbutt Nature Reserve to the southeast which comprises over 180 ha of native bushland.
Priority Investment Areas	Nil



- Legend**
- Study Area
  - Biodiversity Assessment Area (Development Footprint)
  - Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
  - Development Footprint 1500m Buffer
  - Native Vegetation
  - Drainage Line

- IBRA Region:**  
Sydney Basin
- IBRA Subregion:**  
Wyong
- Mitchell Landscape:**  
Gosford - Cooranbong Coastal Slopes

**FIGURE 2.1**  
**Site Map**

## 3.0 Native Vegetation

### 3.1 Methods

#### 3.1.1 Literature and Database Review

A review of previous documents and reports relevant to the vegetation of the Study Area was undertaken. The information obtained was used to inform survey design and assist in the assessment of native vegetation and threatened ecological communities (TECs). Relevant documents included:

- Notice of decision – Newcastle Inner City Bypass Rankin Park to Jesmond (SSI6888) – Approval Document (February 2019)
- Newcastle Inner City Bypass Rankin Park to Jesmond (SSI6888) Secretary Assessment Report (2019)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Biodiversity Assessment Report (GHD 2018)
- Ecological Constraints for a Proposed New Route for State Highway 23 between Rankin Park and Jesmond Report (Umwelt 2006)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Preliminary Environmental Investigation (Parsons Brinckerhoff 2014)
- BioNet Atlas of NSW Wildlife for known/predicted Threatened Ecological Communities (TECs) (DPIE 2020b)
- Protected Matters Search Tool for known/predicted EPBC Act-listed TECs (DAWE 2020).

#### 3.1.2 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Study Area was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment, and vegetation community mapping of the Study Area.

#### 3.1.3 Floristic and Vegetation Integrity Survey

A total of six vegetation integrity plot surveys were conducted within and adjacent to the Study Area in accordance with the BAM (OEH 2017a). These surveys were undertaken over the following survey periods:

- September 2019
- October 2019
- November 2020.

Reference was made to the VIS Classification Database to identify Plant Community Types (PCTs), as well as reviews of other regional and local vegetation mapping and reporting (refer to **Section 3.1.1**) when designing the field survey. The site's PCTs were stratified into condition states following the initial field survey of the site to determine the appropriate number of transect/plots required in accordance with the BAM (OEH 2017a).

**Table 3.1** below outlines the adequacy of the plot flora survey with respect to the BAM (OEH 2017a). **Figure 3.1** show the locations of the plots used in this assessment. Flora species recorded in each plot is provided in **Appendix B**.

**Table 3.1 Adequacy of Vegetation Survey at the Study Area**

Veg Zone	PCT ID and Name <i>Condition Class</i>	Area in the Site (ha)*	Number of BAM Plots/Transects	
			Required (BAM 2017)	Undertaken
1	PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter <i>Moderate to Good</i>	2.3	2	2
2	PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands <i>Moderate to Good</i>	0.7	1	2
3	PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Moderate to Good</i>	1.7	2	2
-	Disturbed/Cleared/Stormwater Basin	4.7	N/A	N/A
<b>TOTAL</b>		<b>9.4</b>	<b>5</b>	<b>6</b>

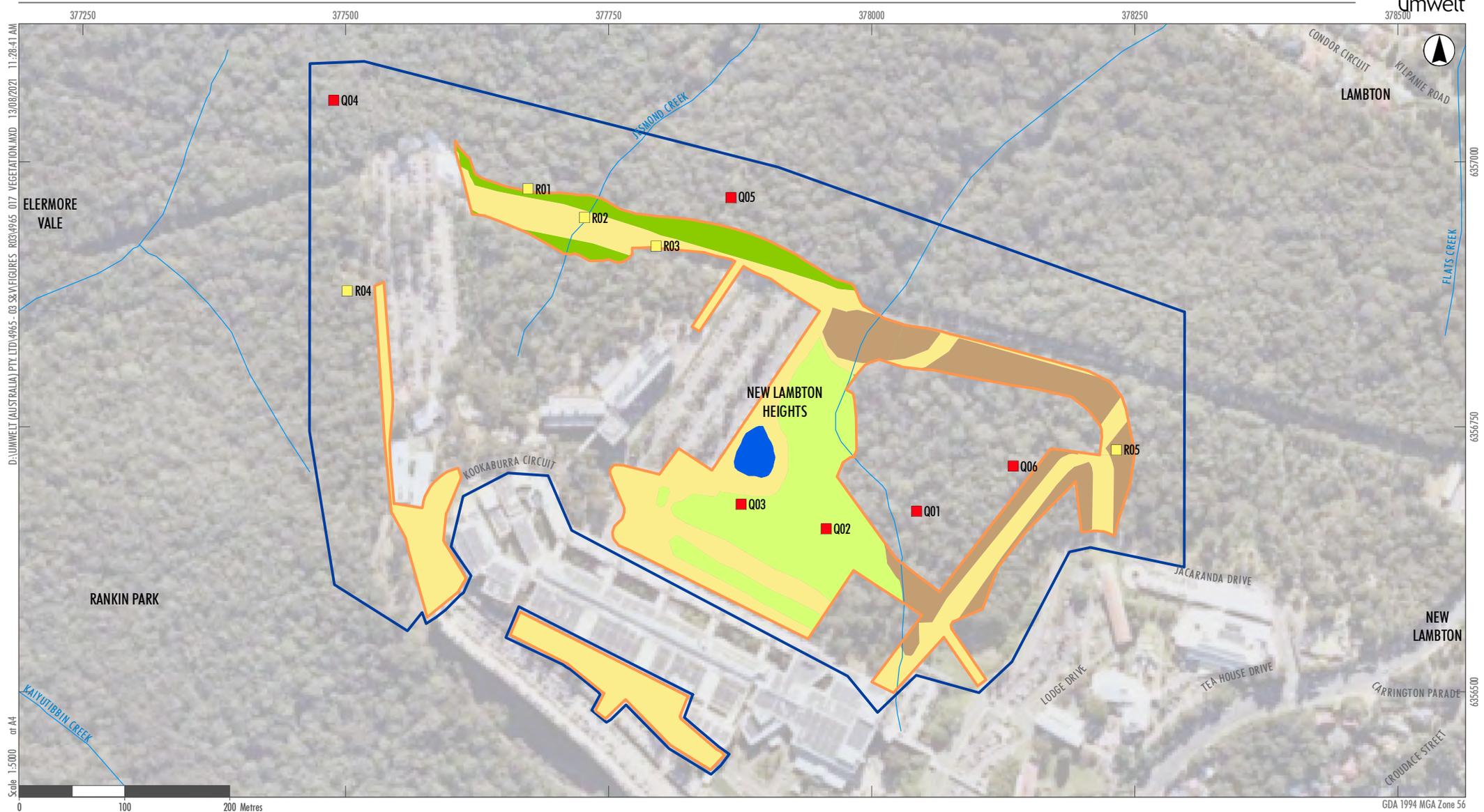
\* Area numbers rounded to one decimal place. All values are subject to minor GIS based discrepancies.

### 3.1.3.1 Floristic Data Collected

At each plot data was recorded in accordance with BAM guidelines (OEH 2017a). A detailed description of the relevant methodologies is provided in **Appendix C**.

### 3.1.4 VIS Benchmarks and MALD

This BAM assessment used the standard benchmarks provided in VIS database and BAM-C. The assessment did not utilise any scaled benchmarks (i.e. drought benchmarks) or More Appropriate Local Data (MALD).



**Legend**

- Study Area
- Biodiversity Assessment Area (Development Footprint)
- BAM Flora Plot
- Rapid Vegetation Assessment
- 1592 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter
- 1619 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
- 1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
- Cleared or Exotic Vegetation
- Stormwater Basin

**FIGURE 3.1**  
**Vegetation Mapping and**  
**Integrity Plot Survey Locations**

### 3.1.5 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Study Area. Vegetation mapping involved the following key steps:

- review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone, and colour, as well as topography
- review of the modelled distribution of vegetation communities within the reports listed in **Section 3.1.1**
- predicting the distribution of particular vegetation communities based on understanding the distribution of Biometric vegetation types and plant communities
- preparation of a draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data, and
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Slight variations in species composition are typical across the extent of a community and are often associated with minor drainage lines or ecotones with other communities.

### 3.1.6 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Study Area were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic quadrat assessment, rapid assessments, and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of ‘important species’ as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth DoEE and the NSW BCD
- comparison with other assessments of TECs in the region.

### 3.1.7 PCT Allocation

The vegetation communities described within the Study Area were aligned with an equivalent PCT as detailed in the VIS Classification Database (OEH 2018). For each vegetation community described in the Site, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCT were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform, and distribution details.

Further detail regarding this allocation for the individual PCTs is outlined in **Section 3.2.1**.

## 3.2 Results

### 3.2.1 Plant Community Types and Vegetation Zones

Surveys of the Study Area identified three PCTs across three condition classes being:

- 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter
  - *Moderate to Good*
- 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
  - *Moderate to Good*
- 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
  - *Moderate to Good.*

These PCTs were aligned with types described as part of the VIS database. The PCTs were then categorised into vegetation zones (refer to **Figure 3.1**). Information on these vegetation zones is provided in the sections below.

### 3.2.1.1 PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter – *Moderate to Good*

PCT Name	Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	
Condition	Moderate to Good	
PCT Formation	KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub-formation)	
PCT Class	Hunter-Macleay Dry Sclerophyll Forests	
PCT Percent Cleared	44.0	
Area	2.3 ha	
Patch Size Class	>100 ha	
Canopy Description	The canopy of this vegetation zone ranges from 12 to 20 m in height and has a cover of approximately 40%. It is dominated by spotted gum ( <i>Corymbia maculata</i> ), red ironbark ( <i>Eucalyptus fibrosa</i> ) and broad-leaved white mahogany ( <i>Eucalyptus umbra</i> ), with occurrences of smooth-barked apple ( <i>Angophora costata</i> ) and small-fruited grey gum ( <i>Eucalyptus propinqua</i> ).	
Mid-storey Description	The mid-storey of this vegetation zone ranges from 1 to 2 m in height and has a cover of approximately 50%. It is dominated by large-leaf hop-bush ( <i>Dodonaea triquetra</i> ) and blackthorn ( <i>Bursaria spinosa</i> ), with occurrences of other shrubs including sunshine wattle ( <i>Acacia terminalis</i> ), prickly Moses ( <i>Acacia ulicifolia</i> ) and narrow-leaved orangebark ( <i>Denhamia silvestris</i> ).	
Ground Cover Description	The ground cover of this vegetation zone is very sparse and reaches up to 1 m in height. It is comprised of a range of rushes, herbs and native grasses, with dominant species including spiny-headed mat-rush ( <i>Lomandra longifolia</i> ), many-flowered mat-rush ( <i>Lomandra multiflora</i> ), blue flax-lily ( <i>Dianella caerulea</i> var. <i>producta</i> ), wiry panic ( <i>Entolasia stricta</i> ), kangaroo grass ( <i>Themeda triandra</i> ), blady grass ( <i>Imperata cylindrica</i> ) and silvertop wallaby grass ( <i>Rytidosperma pallidum</i> ).	
PCT Allocation	Vegetation Zone 1 has been attributed to PCT 1592 based on its position in the landscape and dominant species. It contains approximately 40% of the characteristic species for PCT 1592, including two of the three diagnostic canopy species being spotted gum ( <i>Corymbia maculata</i> ) and red ironbark ( <i>Eucalyptus fibrosa</i> ). Other PCTs with similarities that were also considered during the allocation include 1589 Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast and PCT 1590 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest. While there is significant overlap between PCT 1590 and PCT 1592, PCT 1592 was considered the best fit floristically (containing four of the nine diagnostic species). In addition, this PCT (BVT equivalent) was also mapped in similar landscape positions in proximity to the Development Footprint as part of the extensive studies completed for the RP2J project (GHD 2018)	
BC Act Status	Vegetation Zone 1 is consistent with the <i>Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions</i> EEC listed under the BC Act.	
EPBC Act Status	This vegetation zone is not consistent with any TECs listed under the EPBC Act.	

### 3.2.1.2 PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands – *Moderate to Good*

PCT Name	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	
Condition	Moderate to Good	
PCT Formation	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	
PCT Class	Sydney Coastal Dry Sclerophyll Forests	
PCT Percent Cleared	45.0	
Area	0.7 ha	
Patch Size Class	>100 ha	
Canopy Description	The canopy of this vegetation zone ranges from 15 to 25 m in height and has a cover of approximately 30%. It is dominated by smooth-barked apple ( <i>Angophora costata</i> ) and red bloodwood ( <i>Corymbia gummifera</i> ), with occurrences of broad-leaved white mahogany.	
Mid-storey Description	The mid-storey of this vegetation zone ranges from 1 to 2 m in height and has a cover of approximately 10%. It is dominated by hairpin banksia ( <i>Banksia spinulosa</i> ) and sunshine wattle ( <i>Acacia terminalis</i> ), with occurrences of other shrubs including tea tree ( <i>Leptospermum</i> sp.), <i>Hovea linearis</i> and sweet pittosporum ( <i>Pittosporum undulatum</i> ).	
Ground Cover Description	The ground cover of this vegetation zone is sparse and reaches up to 1 m in height. It is comprised of a range of rushes, herbs and native grasses, with dominant species including <i>Lomandra obliqua</i> , many-flowered mat-rush ( <i>Lomandra multiflora</i> subsp. <i>multiflora</i> ), blue flax-lily ( <i>Dianella caerulea</i> var. <i>producta</i> ), thyme spurge ( <i>Phyllanthus hirtellus</i> ), wiry panic ( <i>Entolasia stricta</i> ), kangaroo grass ( <i>Themeda triandra</i> ) and silvertop wallaby grass ( <i>Rytidosperma pallidum</i> ).	
PCT Allocation	Vegetation Zone 2 has been attributed to PCT 1619 based on its position in the landscape and dominant species. It contains approximately 40% of the characteristic species for PCT 1619, including two of the three diagnostic canopy species being smooth-barked apple ( <i>Angophora costata</i> ) and red bloodwood ( <i>Corymbia gummifera</i> ). Other PCTs that were also considered during the allocation include PCT 1579 Smooth-barked Apple - Turpentine - Blackbutt open forest on ranges of the Central Coast and 1621 Smooth-barked Apple open forest on coastal lowlands of the Central Coast however landscape position, species assemblage and key diagnostic species were the determining factors and PCT 1619 was the best fit. In addition, this PCT (BVT equivalent) was also mapped in similar landscape positions in proximity to the Development Footprint as part of the extensive studies completed for the RP2J project (GHD 2018).	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act.	
EPBC Act Status	This vegetation zone is not consistent with any TECs listed under the EPBC Act.	

### 3.2.1.3 PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast – *Moderate to Good*

<b>PCT Name</b>	Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	
<b>Condition</b>	Moderate to Good	
<b>PCT Formation</b>	KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub-formation)	
<b>PCT Class</b>	Hunter-Macleay Dry Sclerophyll Forests	
<b>PCT Percent Cleared</b>	9.0	
<b>Area</b>	1.7 ha	
<b>Patch Size Class</b>	>100 ha	
<b>Canopy Description</b>	The canopy of this vegetation zone ranges from 12 to 22 m in height and has a cover of approximately 30%. It is dominated by smooth-barked apple ( <i>Angophora costata</i> ), Sydney peppermint ( <i>Eucalyptus piperita</i> ) and broad-leaved white mahogany ( <i>Eucalyptus umbra</i> ).	
<b>Mid-storey Description</b>	The canopy of this vegetation zone ranges from 1 to 1.5 m in height and has a cover of approximately 7%. It is dominated by regenerating eucalypts and prickly Moses ( <i>Acacia ulicifolia</i> ), with occurrences of hairpin banksia ( <i>Banksia spinulosa</i> var. <i>collina</i> ), an <i>Allocasuarina</i> sp. large-leaf hop-bush ( <i>Dodonaea triquetra</i> ), and blackthorn ( <i>Bursaria spinosa</i> ).	
<b>Ground Cover Description</b>	The ground cover of this vegetation zone is very sparse and reaches up to 1 m in height. It is comprised of a range of rushes, herbs, sub-shrubs and native grasses, with dominant species including purple coral pea ( <i>Hardenbergia violacea</i> ), slender rice flower ( <i>Pimelea linifolia</i> ), <i>Lomandra obliqua</i> , blue flax-lily ( <i>Dianella caerulea</i> var. <i>producta</i> ), wattle mat-rush ( <i>Lomandra filiformis</i> ), wiry panic ( <i>Entolasia stricta</i> ), kangaroo grass ( <i>Themeda triandra</i> ) and silvertop wallaby grass ( <i>Rytidosperma pallidum</i> ).	
<b>PCT Allocation</b>	Vegetation Zone 3 has been attributed to PCT 1627 based on its position in the landscape and dominant species. Approximately 40% of the characteristic species for PCT 1627, including two of the four diagnostic canopy species being smooth-barked apple ( <i>Angophora costata</i> ) and Sydney peppermint ( <i>Eucalyptus piperita</i> ) were recorded in this vegetation zone. Other PCTs that were also considered during the allocation include PCT 1579 Smooth-barked Apple - Turpentine - Blackbutt open forest on ranges of the Central Coast and 1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion. While these PCTs share similar species, PCT 1627 was the best fit floristically and topographically. In addition, this PCT (BVT equivalent) was also mapped in similar landscape positions in proximity to the Development Footprint as part of the extensive studies completed for the RP2J project (GHD 2018)	
<b>BC Act Status</b>	This vegetation zone is not consistent with any TECs listed under the BC Act.	
<b>EPBC Act Status</b>	This vegetation zone is not consistent with any TECs listed under the EPBC Act.	

### 3.2.2 Threatened Ecological Communities

One TEC was recorded within the Study Area (**Figure 3.2**), being the *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions* Endangered Ecological Community (EEC) listed under the BC Act. A total of 2.3 ha of this EEC occurs as PCT 1592 and will be removed as part of the Project.

This EEC is known to occur principally on Permian and Carboniferous geology in the central to lower Hunter Valley (NSW TSSC 2019), with smaller areas of the community occurring on the Permian Singleton and Newcastle Coal Measures and the Triassic Narrabeen Group. This TEC was identified and mapped nearby as part of the Rankin Park to Jesmond Bypass (GHD 2018).

The *Lower Hunter Spotted Gum – Ironbark Forest* EEC is a community comprising spotted gum (*Corymbia maculata*) and broad-leaved ironbark (*Eucalyptus fibrosa*), while grey gum (*E. punctata*) and narrow-leaved ironbark (*E. crebra*) occur occasionally. In an undisturbed condition the structure of the community is typically open forest. If thinning has occurred, it may take the form of woodland or a dense thicket of saplings, depending on post-disturbance regeneration (NSW TSSC 2019). Whilst the vegetation occurring within the Study Area had varying levels of previous disturbance including thinning for bushfire management purposes (APZ) it still contained both indicative canopy species, being spotted gum (*Corymbia maculata*) and broad-leaved ironbark (*Eucalyptus fibrosa*).

Analysis of consistency with the scientific determination for the TEC was undertaken, with consideration of the advice provided by the NSW Scientific Committee guidelines for interpreting listed ecological communities under the BC Act.



- Legend**
- Study Area
  - Biodiversity Assessment Area (Development Footprint)
  - Drainage Line
- BC Act - TEC:**
- Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions

**FIGURE 3.2**  
**Threatened Ecological Communities**

Image Source: Nearmap (2021) Data source: DFSI (2020)

### 3.2.2.1 Summary of TECs within the Development Footprint

Table 3.2 provides a summary of the TECs and the area they occupy within the Development Footprint

**Table 3.2 Summary of TECs within the Development Footprint**

Threatened Ecological Community	BC Act Listing Status	Area (ha)
BC Act		
<i>Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions</i>	EEC	2.3

### 3.2.3 Vegetation Integrity Score

Table 3.3 below details the vegetation integrity scores for each of the vegetation zones in the Site. The vegetation integrity data for each of the vegetation zones is provided in **Appendix A**.

**Table 3.3 Vegetation Zone Vegetation Integrity Scores**

Veg Zone	PCT Name <i>Condition Class</i>	Composition	Structure	Function	Current Vegetation Integrity Score
1	PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter <i>Moderate to Good</i>	58.3	50.1	73.4	<b>59.8</b>
2	PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands <i>Moderate to Good</i>	46.8	51.7	45.8	<b>48</b>
3	PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Moderate to Good</i>	64.4	37.7	66.4	<b>54.4</b>

## 4.0 Threatened Species

### 4.1 Methods

#### 4.1.1 Literature and Database Review

A review of previous documents and reports relevant to threatened species within the Study Area was undertaken. The information obtained was used to inform survey design and assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents included:

- Threatened Biodiversity Data Collection (TDBC)
- DPIE BioNet Atlas of NSW Wildlife
- PlantNET (Royal Botanic Gardens Sydney) database search for Rare or Threatened Australian Plant species
- DAWE Protected Matters Search Tool for known/predicted EPBC Act-listed species.

#### 4.1.2 Species-credit Species Surveys

An assessment of candidate species-credit species was completed in accordance with Section 6.4.1 of the BAM. For those candidate species considered to have the potential to occur within the Study Area, targeted survey and opportunistic searches were undertaken. Species-credit species surveys were undertaken over multiple seasons, including:

- 24 and 25 September 2019
- 22 and 23 October 2019
- 16 December 2019
- 20 and 21 January 2020
- 11 and 12 February 2020
- 9, 10, 11, 19 and 20 March 2020
- 19, 21, 26 and 31 August 2020
- 15 September 2020
- 24 November 2020.

The species targeted for surveys and methods of survey are provided in **Appendix E**.

#### 4.1.2.1 Weather Conditions and Limitations

**Table 4.1** below outlines the weather conditions for the surveys. Data is derived from the Newcastle University weather station (061390) from the Bureau of Meteorology.

**Table 4.1 Weather Conditions for Species-credit Surveys**

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
24 September 2019	6.8-20.6	0	50	10.6-22.8	88.3	69
25 September 2019	8.4-21.2	0	49			
22 October 2019	NR	0	NR	13.1-25.3	32.2	65
23 October 2019	NR-27.2	0	NR			
16 December 2019	18.8-23.2	0	69	17.9-30.4	0.0	61
20 January 2020	19.6-31.2	0	76	21.3-30.7	39.8	73
21 January 2020	18.4-34.3	0.4	40			
11 February 2020	18.8-30.2	3.2	87	19.8-28.7	219.6	79
12 February 2020	21.2-27.2	0	92			
9 March 2020	16.8-23.8	0	92			
10 March 2020	17.0-25.8	0	71	16.9-26.6	182.4	79
11 March 2020	15.6-25.2	0	78			
19 March 2020	14.2-31.2	0	84			
20 March 2020	16.4-34.0	0	73			
19 August 2020	7.2-21.0	0	60			
21 August 2020	7.8-NR	0	58			
26 August 2020	3.8-19.2	0	57			
31 August 2020	9.5-26.3	0	48			
15 September 2020	13.8-23.4	0	74	11.5-23.8	25.2	67
24 November 2020	18.6-22.2	0	75	17.3-24.1	42.6	34

NR= Not Recorded

During late 2019 and early-mid 2020 surveys were conducted during periods classed as “drought affected” and “drought”, with a “recovery” period only occurring in September 2020 (DPI 2020). These ongoing drought conditions may have affected the growth of flora species and resulted in limited detection of some species when compared to periods of non-drought.

For some herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. Where specimens were of potential significance they were forwarded to the National Herbarium of New South Wales for identification.

### 4.1.3 Koala SEPP 2021

The City of Newcastle is listed in Schedule 1 as an LGA to which the Koala SEPP 2021 (Koala SEPP) applies and there is currently no approved Koala Plan of Management for the LGA. The development assessment process therefore must consider the Koala SEPP. The Koala SEPP requires an appropriately qualified and experienced person to determine if the development footprint contains core koala habitat. Core koala habitat, as defined by the Koala SEPP, is:

a) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or

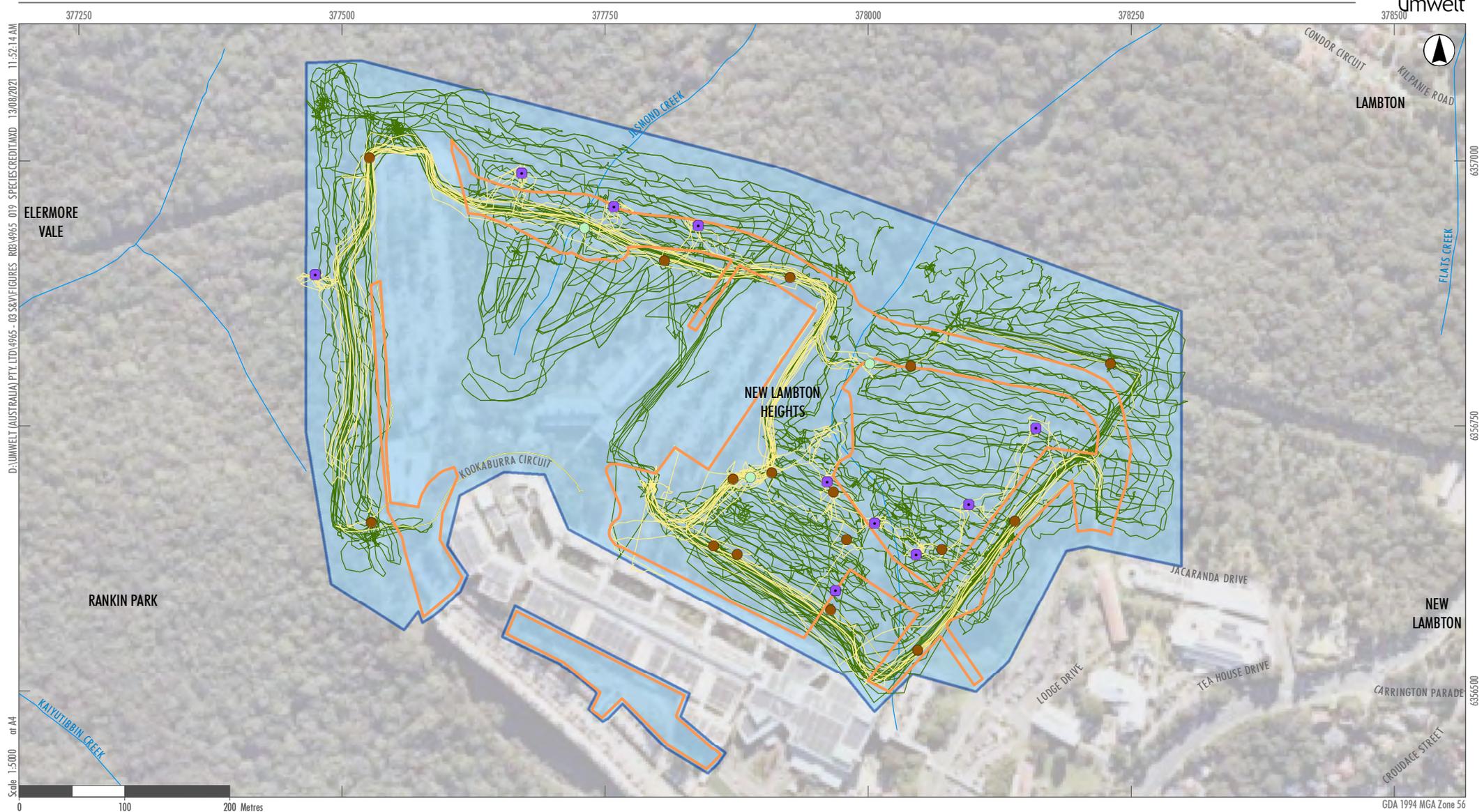
(b) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years.

Assessment of the development footprint and surrounds was completed during ecological surveys completed across the Development Footprint. Nocturnal and diurnal surveys were also completed as described in **Appendix E**.

## 4.2 Results

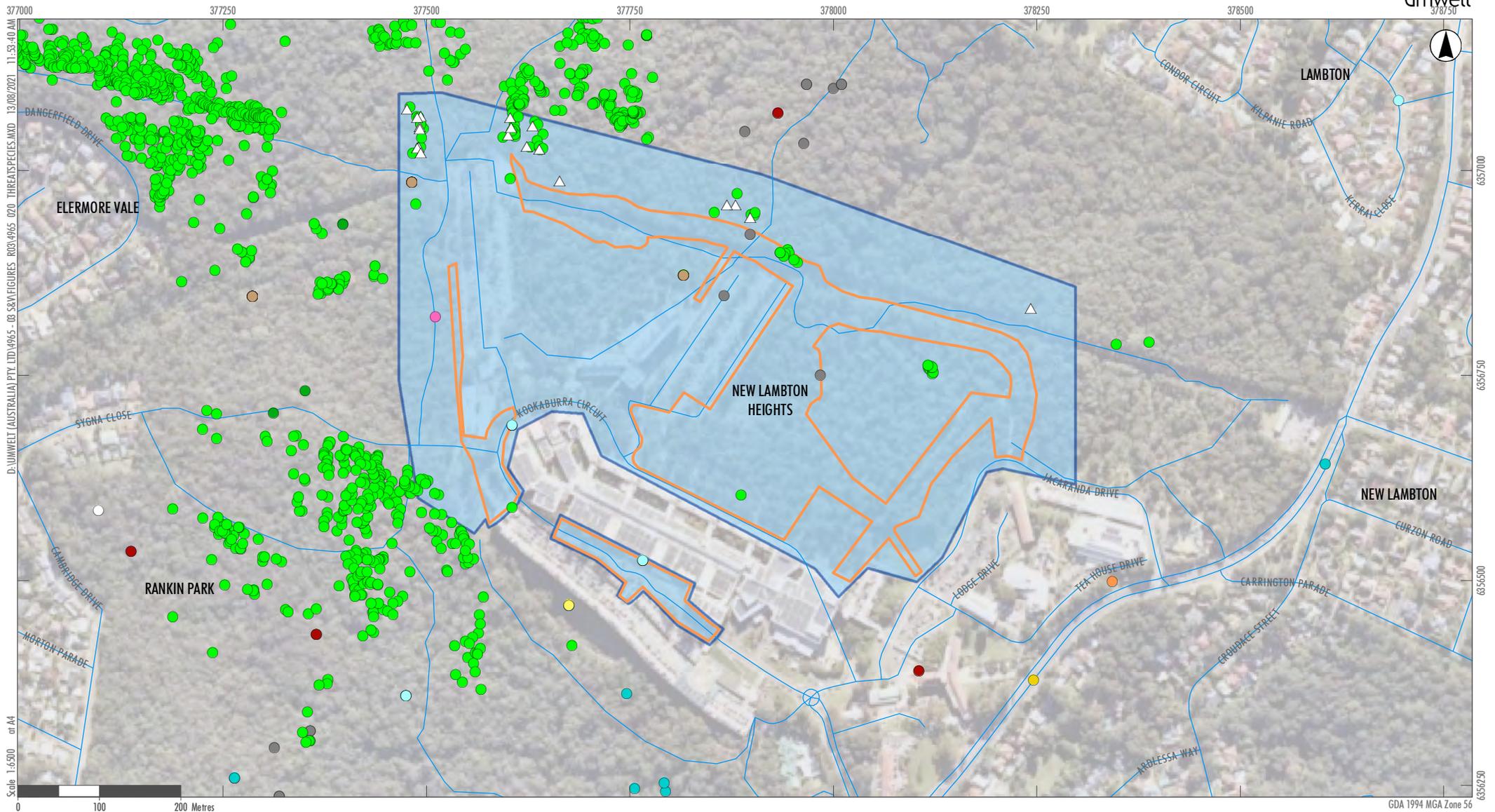
### 4.2.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and literature review, and whether they have been recorded within the Development Footprint is provided in **Appendix D**.



- Legend**
- Study Area
  - Biodiversity Assessment Area (Development Footprint)
  - Drainage Line
  - Targeted Species-credit Flora Transects
  - Spotlight Survey
  - Targeted Forest Owl Call Playback and Stag Watch
  - Targeted Threatened Amphibian Survey
  - Remote Cameras

**FIGURE 4.1**  
**Species-credit Species Survey Locations**



**Legend**

- Study Area
- Biodiversity Assessment Area (Development Footprint)
- Drainage Line

**Umwelt Threatened Species:**

- Black-eyed Susan (*Tetratheca juncea*)

**Bionet ATLAS Threatened Species:**

- |  |  |  |
|--|--|--|
| <span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%; margin-right: 5px;"></span> Black-eyed Susan                 | <span style="display: inline-block; width: 10px; height: 10px; background-color: purple; border-radius: 50%; margin-right: 5px;"></span> Greater Broad-nosed Bat | <span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Magenta Lilly Pilly                        |
| <span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%; margin-right: 5px;"></span> Eastern Coastal Free-tailed Bat | <span style="display: inline-block; width: 10px; height: 10px; background-color: brown; border-radius: 50%; margin-right: 5px;"></span> Large Bent-winged Bat    | <span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%; margin-right: 5px;"></span> Masked Owl               |
| <span style="display: inline-block; width: 10px; height: 10px; background-color: orange; border-radius: 50%; margin-right: 5px;"></span> Gang-gang Cockatoo              | <span style="display: inline-block; width: 10px; height: 10px; background-color: darkred; border-radius: 50%; margin-right: 5px;"></span> Little Bent-winged Bat | <span style="display: inline-block; width: 10px; height: 10px; background-color: cyan; border-radius: 50%; margin-right: 5px;"></span> Powerful Owl            |
| <span style="display: inline-block; width: 10px; height: 10px; background-color: pink; border-radius: 50%; margin-right: 5px;"></span> Glossy Black-Cockatoo             | <span style="display: inline-block; width: 10px; height: 10px; background-color: purple; border-radius: 50%; margin-right: 5px;"></span> Little Lorikeet         | <span style="display: inline-block; width: 10px; height: 10px; background-color: green; border-radius: 50%; margin-right: 5px;"></span> Small-flower Grevillea |
|  |  | <span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%; margin-right: 5px;"></span> Spotted-tailed Quoll  |
|  |  | <span style="display: inline-block; width: 10px; height: 10px; background-color: grey; border-radius: 50%; margin-right: 5px;"></span> Squirrel Glider         |

**FIGURE 4.2**  
**Ecosystem-credit Species Records**

## 4.2.2 Species-credit Species

Targeted species-credit surveys were undertaken across the Study Area and Development Footprint as described in **Appendix E. Table 4.2** outlines the species-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they were recorded or are considered likely to occur in the Development Footprint.

**Table 4.2 Species-credit Species**

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
<b>Flora</b>			
<b>Bynoe's wattle</b> <i>Acacia bynoeana</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>Charmhaven apple</b> <i>Angophora inopina</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>thick-leaf star-hair</b> <i>Astrotricha crassifolia</i>	Very High	-	<b>Absent</b> – not recorded during surveys.
<b>thick lip spider orchid</b> <i>Caladenia tessellata</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<b>netted bottle brush</b> <i>Callistemon linearifolius</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<b>dwarf kerrawang</b> <i>Commersonia prostrata</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>Corunastylis sp. Charmhaven (NSW896673)</b>	High	-	<b>Absent</b> – not recorded during surveys.
<b>leafless tongue-orchid</b> <i>Cryptostylis hunteriana</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<b>white-flowered wax plant</b> <i>Cynanchum elegans</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b><i>Diuris bracteata</i></b>	High	-	<b>Absent</b> – not recorded during surveys.
<b>Rough Doubletail</b> <i>Diuris praecox</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<b>Camfield's stringybark</b> <i>Eucalyptus camfieldii</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b><i>Eucalyptus camaldulensis</i> population in the Hunter catchment</b> <i>Eucalyptus camaldulensis</i>	High	Floodplains of watercourses, including rivers, creeks, intermittent streams, or billabongs.	<b>Absent</b> – not recorded during surveys.
<b>slaty red gum</b> <i>Eucalyptus glaucina</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>Earp's gum</b> <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b><i>Euphrasia arguta</i></b>	High	-	<b>Absent</b> – not recorded during surveys.
<b>variable midge orchid</b> <i>Genoplesium insigne</i>	High	-	<b>Absent</b> – not recorded during surveys.

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
small-flower grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	High	-	<b>Absent</b> – not recorded during surveys.
<i>Grevillea shiressii</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<i>Maundia triglochinosoides</i>	High	Riparian areas/drainage lines, water ponding, man-made dams, and drainage channels up to 1 m deep.	<b>Absent</b> – not recorded during surveys.
biconvex paperbark <i>Melaleuca biconvexa</i>	High	-	<b>Absent</b> – not recorded during surveys.
Grove's paperbark <i>Melaleuca groveana</i>	High	-	<b>Absent</b> – not recorded during surveys.
scrambling lignum <i>Muehlenbeckia costata</i>	High	Rocky areas or within 50m or rocky areas.	<b>Absent</b> – not recorded during surveys.
knotweed <i>Persicaria elatior</i>	High	Semi-permanent/ephemeral wet areas, swamps, wetlands, or waterbodies or within 50 m.	<b>Absent</b> – not recorded during surveys.
lesser swamp-orchid <i>Prasophyllum</i> sp. <i>Wybong</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
tranquillity mintbush <i>Prostanthera askania</i>	High	-	<b>Absent</b> – not recorded during surveys.
Somersby mintbush <i>Prostanthera junonis</i>	High	-	<b>Absent</b> – not recorded during surveys.
Illawarra greenhood <i>Pterostylis gibbosa</i>	High	-	<b>Absent</b> – not recorded during surveys.
coast headland pea <i>Pultenaea maritima</i>	High	-	<b>Absent</b> – not recorded during surveys.
eastern underground orchid <i>Rhizanthella slateri</i>	High	-	<b>Absent</b> – not recorded during surveys.
scrub turpentine <i>Rhodamnia rubescens</i>	High	-	<b>Absent</b> – not recorded during surveys.
native guava <i>Rhodomyrtus psidioides</i>	High	-	<b>Absent</b> – not recorded during surveys.
heath wrinklewort <i>Rutidosis heterogama</i>	High	-	<b>Absent</b> – not recorded during surveys.
rainforest cassia <i>Senna acclinis</i>	High	-	<b>Absent</b> – not recorded during surveys.
magenta lilly pilly <i>Syzygium paniculatum</i>	High	-	<b>Absent</b> – not recorded during surveys.
<i>Tetratheca glandulosa</i>	High	-	<b>Absent</b> – not recorded during surveys.
black-eyed Susan <i>Tetratheca juncea</i>	High	-	<b>Present</b> – recorded during surveys.

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
<i>Zannichellia palustris</i>	High	Freshwater or slightly brackish estuarine areas (10%).	<b>Absent</b> – not recorded during surveys.
<b>Fauna</b>			
<b>regent honeyeater</b> <i>Anthochaera phrygia</i>	High	Important habitat only (as defined by mapping products supplied by the BCD).	<b>Absent</b> – no breeding habitat recorded during surveys. Surveys are not required for this species under the BAM due to lack of important habitat within the Development Footprint being confirmed through BCD mapping products.
<b>bush stone-curlew</b> <i>Burhinus grallarius</i>	High	Fallen/standing dead timber including logs.	<b>Absent</b> – not recorded during surveys.
<b>glossy black-cockatoo</b> <i>Calyptorhynchus lathami</i>	High	Breeding habitat only. Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	<b>Absent</b> – breeding behaviour not recorded during surveys.
<b>gang-gang cockatoo</b> <i>Callocephalon fimbriatum</i>	High	Breeding habitat only. Eucalypt tree species with hollows greater than 9 cm diameter.	<b>Absent</b> – breeding behaviour not recorded during surveys.
<b>eastern pygmy-possum</b> <i>Cercartetus nanus</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>large-eared pied bat</b> <i>Chalinolobus dwyeri</i>	Very High	Breeding habitat only. Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	<b>Absent</b> – no suitable breeding habitat occurs within the Development Footprint.
<b>Wallum froglet</b> <i>Crinia tinnula</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<b>red goshawk</b> <i>Erythrorhynchus radiatus</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>white-bellied sea-eagle</b> <i>Haliaeetus leucogaster</i>	High	Breeding habitat only. Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands, and coastlines.	<b>Absent</b> – not recorded during surveys.
<b>giant burrowing frog</b> <i>Heleioporus australiacus</i>	Moderate	Hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features.	<b>Absent</b> – no suitable habitat occurs within the Development Footprint.

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
little eagle <i>Hieraaetus morphnoides</i>	Moderate	Breeding habitat only. Nest trees - live (occasionally dead) large old trees within vegetation.	<b>Absent</b> – not recorded during surveys.
white-throated needletail <i>Hirundapus caudacutus</i>	N/A	-	<b>Absent</b> – not recorded during surveys.
pale-headed snake <i>Hoplocephalus bitorquatus</i>	High	-	<b>Absent</b> – not recorded during surveys.
swift parrot <i>Lathamus discolor</i>	Moderate	Important habitat only (as defined by mapping products supplied by the BCD)	<b>Absent</b> – no breeding habitat recorded during surveys. Surveys are not required for this species under the BAM due to lack of important habitat within the Development Footprint being confirmed through BCD mapping products.
green and golden bell frog <i>Litoria aurea</i>	High	Semi-permanent/ephemeral wet areas and within 1km of swamps and waterbodies.	<b>Absent</b> – not recorded during surveys.
green-thighed frog <i>Litoria brevipalmata</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
Littlejohn's tree frog <i>Litoria littlejohni</i>	High	-	<b>Absent</b> – not recorded during surveys.
square-tailed kite <i>Lophoictinia isura</i>	Moderate	Breeding habitat only. Nest trees.	<b>Absent</b> – not recorded during surveys.
little bent-winged bat <i>Miniopterus australis</i>	Very High	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	<b>Absent</b> – no suitable breeding habitat occurs within the Development Footprint.
large bentwing-bat <i>Miniopterus orianae oceanensis</i>	Very High	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	<b>Absent</b> – no suitable breeding habitat occurs within the Development Footprint.
stuttering frog <i>Mixophyes balbus</i>	Very High	-	<b>Absent – Habitat Degraded</b> - no suitable habitat identified during surveys.
southern myotis <i>Myotis macropus</i>	High	Breeding habitat only. Hollow bearing trees within 200 m of riparian zone. Bridges, caves, or artificial structures within 200 m of riparian zone.	<b>Absent</b> – no suitable breeding habitat occurs within the Development Footprint.

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
<b>barking owl</b> <i>Ninox connivens</i>	High	Breeding habitat only. Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	<b>Absent</b> – not recorded during surveys.
<b>powerful owl</b> <i>Ninox strenua</i>	High	Breeding habitat only. Living or dead trees with hollow greater than 20cm diameter.	<b>Absent</b> – known to occur proximate to Development Footprint however breeding behaviour not recorded during surveys.
<b>eastern osprey</b> <i>Pandion cristatus</i>	Moderate	-	<b>Absent</b> – not recorded during surveys.
<b>greater glider</b> <i>Petauroides volans</i>	High	Hollow-bearing trees.	<b>Absent</b> – not recorded during surveys.
<b>squirrel glider</b> <i>Petaurus norfolcensis</i>	High	-	<b>Present</b> – Previously recorded within the Development Footprint (DPIE 2020b).
<b>brush-tailed rock-wallaby</b> <i>Petrogale penicillata</i>	Very High	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	<b>Absent – Habitat Degraded</b> - no suitable habitat identified during surveys.
<b>brush-tailed phascogale</b> <i>tapoatafa</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>koala</b> <i>Phascolarctos cinereus</i>	High	Important habitat only	<b>Absent</b> – not recorded during surveys.
<b>common planigale</b> <i>Planigale maculata</i>	High	-	<b>Absent</b> – not recorded during surveys.
<b>long-nosed potoroo</b> <i>Potorous tridactylus</i>	High	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).	<b>Absent – Habitat Degraded</b> - no suitable habitat identified during surveys.
<b>red-crowned toadlet</b> <i>Pseudophryne australis</i>	Moderate	-	<b>Absent – Habitat Degraded</b> - no suitable habitat identified during surveys.
<b>grey-headed flying-fox</b> <i>Pteropus poliocephalus</i>	High	Breeding camps.	<b>Absent</b> – no breeding camps occur within the Development Footprint.
<b>golden sun moth</b> <i>Synemon plana</i>	Moderate	Wallaby grass ( <i>Rytidosperma</i> sp.), Chilean needlegrass ( <i>Nassella nessiana</i> ) or serrated tussock ( <i>Nassella trichotoma</i> )	<b>Absent – Habitat Degraded</b> - no suitable habitat identified during surveys.
<b>red-backed button-quail</b> <i>Turnix maculosus</i>	High	-	<b>Absent</b> – not recorded during surveys.

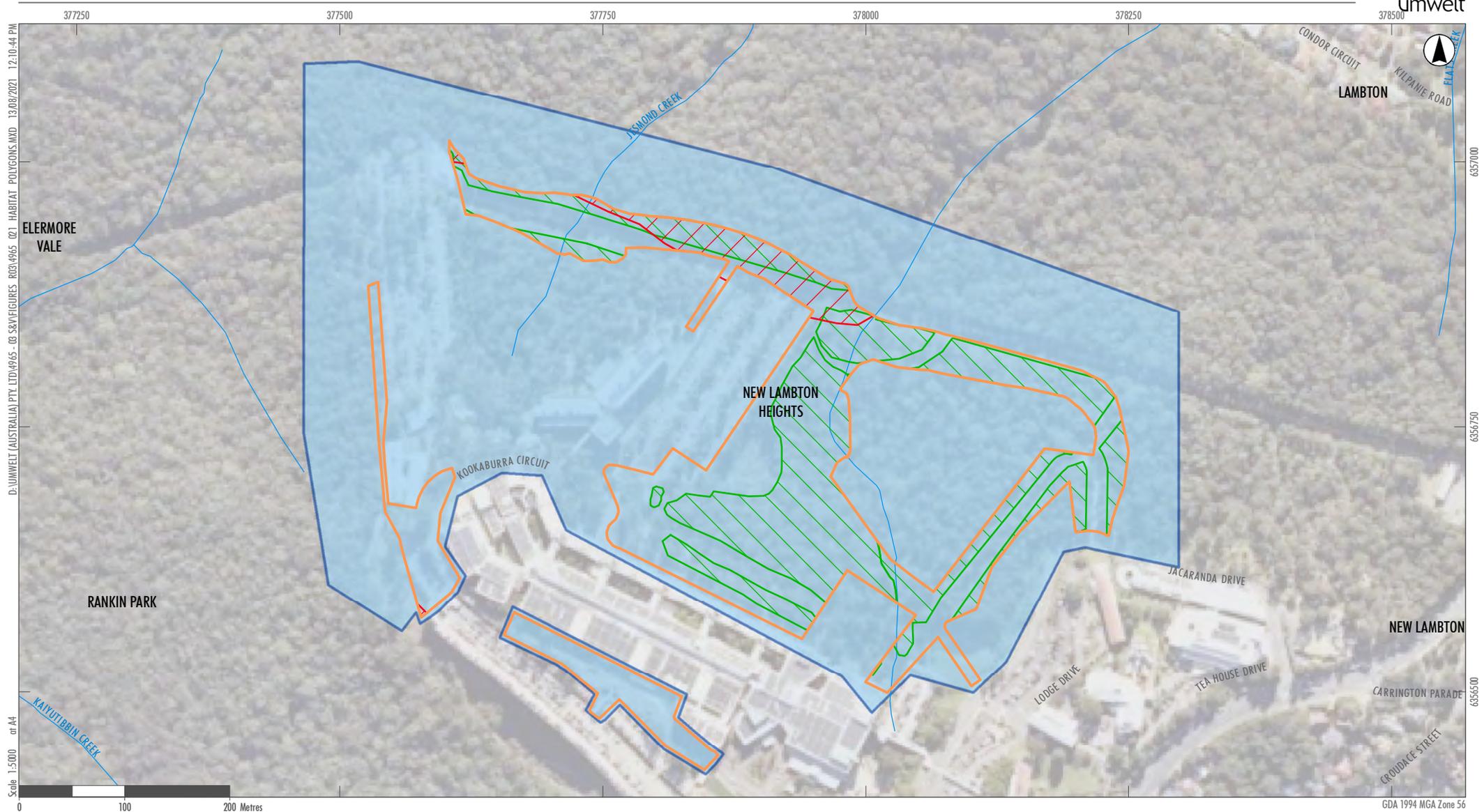
Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
masked owl <i>Tyto novaehollandiae</i>	High	Breeding habitat only. Living or dead trees with hollows greater than 20cm diameter.	<b>Absent</b> – not recorded during surveys.
sooty owl <i>Tyto tenebricosa</i>	Very High	Breeding habitat only. Caves or clifflines/ledges. Living or dead trees with hollows greater than 20cm diameter.	<b>Absent</b> – not recorded during surveys.
Mahony's toadlet <i>Uperoleia mahonyi</i>	High	-	<b>Absent</b> – not recorded during surveys.
eastern cave bat <i>Vespadelus troughtoni</i>	Very High	Breeding habitat only. Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices, or boulder piles, or within two kilometres of old mines, tunnels, old buildings, or sheds.	<b>Absent</b> – no suitable breeding habitat occurs within the Development Footprint.

#### 4.2.2.1 Species Habitat Polygons

Species polygons have been prepared for the species outlined in **Table 4.3** below. Habitat polygons are shown on **Figure 4.3**.

**Table 4.3 Species-credit Species Habitat Polygons and Risk Weightings**

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
black-eyed Susan <i>Tetratheca juncea</i>	2	0.44	Species polygon boundaries consistent with those assessed by GHD (2018). All individual in the Study Area were within the sub-population mapping completed by WSP (2016) for the Approved Rankin Park to Jesmond Bypass Biodiversity Assessment Report (GHD 2018). Species polygon boundaries aligns with intact PCTs within the site, 1619 (0.4ha) and 1627 (0.04ha)
squirrel glider <i>Petaurus norfolcensis</i>	2	4.7	Species polygon boundaries aligns with intact PCTs within the site to which the species is associated in the TBDC (1592 (2.3ha), 1619 (0.7ha) and 1627 (1.7ha))



- Legend
- Study Area
  - Biodiversity Assessment Area (Development Footprint)
  - Tetratheca juncea* Species Polygon
  - Squirrel Glider Species Polygon
  - Drainage Line

FIGURE 4.3  
Species Habitat Polygons

## 4.2.3 Koala SEPP 2021

### 4.2.3.1 Assessment of Core Habitat

Core koala habitat, as defined by the Koala SEPP, is:

- a. an area of land which has been assessed by a suitably qualified and experienced person as being *highly suitable koala habitat* and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or
- b. an area of land which has been assessed by a suitably qualified and experienced person as being *highly suitable koala habitat* and where koalas have been recorded as being present in the previous 18 years.

Six of the tree species listed in Schedule 2 of the Koala SEPP (Central Coast Koala Management Area) have been recorded within the Development Footprint. These tree species represent 15% or greater of the total number of trees within any Plant Community Type (PCT) and as such, all PCTs across the Development Footprint represent *highly suitable habitat* for the koala.

Despite the Development Footprint representing *highly suitable habitat*, the koala was not recorded in the Development Footprint despite extensive ecological survey. In addition, a review of the Bionet Atlas of NSW Wildlife reveals two records of this species within 2.5 kilometres of the Development Footprint. Both of these records are proximate to Blackbutt Reserve and the observation date on both records is 1986 (35 years old).

As a result, the Development Footprint does not represent core koala habitat as the koala was not recorded in the Development Footprint and koalas have not been recorded nearby (within 2.5 kilometres in the Central Coast Koala Management Area) within the last 18 years. No further provisions of the Koala SEPP apply.

Notwithstanding, the koala is a dual ecosystem and species credit species under the BAM and has been further considered in **Appendix D**.

## 5.0 Avoidance and Minimisation

### 5.1 Avoidance Measures in Project Design

The Project has sought, as far as practicable, to avoid and minimise potential impacts on the ecological values of the Study Area throughout the Project planning process. This included several changes to the Northern Access Road to reduce cut/fill requirements and biodiversity impacts associated with large batters. In addition, the design applies Acceptable Solutions of Planning for Bushfire Protection 2019 to minimise disturbances associated with Asset Protection Zones (APZs).

Where possible, the Project has restricted the development footprint to previously disturbed areas including existing fire trails and easements. This includes the proposed construction access road and lead in services/services connections utilising least disruptive methodologies (sewer drainage) and utilising targeted services 'zones' that align within disturbed areas such as roads as well as a reduction in clearing required for the APZ through co-location of civil works and stormwater basins.

The footprint of the ASB has been rationalised whilst meeting clinical objectives, through vertical blocking and stacking to reduce impact of the footprint. The car parking is proposed within the semi-basement of the ASB to minimise further impact resulting from alternative options that considered separate car parking structures.

### 5.2 Minimisation and Mitigation Measures during Construction

The Project has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project. The following specific control measures are considered to be integral to the mitigation of impacts on the biodiversity features of the Study Area:

- salvage of biodiversity features, including habitat resources (e.g. hollow logs, tree hollows, fallen timber and rocks/boulders)
- a pre-clearing procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees. The pre-clearing procedure is designed to minimise impacts to hollow-dependent and ground-dwelling fauna
- weed management
- fencing and access control
- bushfire management
- erosion and sedimentation control
- workforce education and training.

Each of these control measures will contribute to the maintenance of habitat quality in proximity to the Development Footprint.

## 5.2.1 Pre-clearance and tree-felling

Pre-clearance surveys and tree-felling supervision recommendations will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

### 5.2.1.1 Pre-clearance surveys

Pre-clearance surveys are to be undertaken prior to tree felling works, be undertaken by suitably qualified and experienced persons/personnel and include:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing
- habitat resources and habitat trees should be identified and marked (Note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows, and boulder piles)
- the potential presence of threatened flora and fauna species, endangered populations and TECs should be identified
- the identification of threatened species or habitat features that are suitable for translocation or salvage
- disturbance activities should be targeted to specific times of the year to minimise impacts to threatened species usage of habitat features for breeding and roosting, where practicable.

Nest boxes previously installed within the Development Footprint will be removed and relocated (in accordance with the relevant consent requirements) during this process.

### 5.2.1.2 Tree-felling supervision

Tree felling will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential habitat features.

The tree-felling process will include the following:

#### **Prior to Felling Habitat Trees**

- Completion of actions recommended from the pre-clearing surveys, including (but not limited to) salvage of identified habitat features, additional surveys to determine threatened fauna usage of the area (if required), identification of active dens or burrows, any actions required to discourage fauna occupation and weed or feral fauna management requirements
- Removal of non-habitat trees/vegetation as close to the habitat tree felling date as possible in order to create disturbance to discourage fauna usage of the habitat trees
- Shaking of habitat trees (with heavy machinery) as appropriate to encourage fauna to abandon trees.

#### **On the Day of Felling Habitat Trees**

- All habitat trees will be subject to a visual inspection to survey for threatened species
- Trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified
- The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery

- If a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats
- Uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time
- Injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment
- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised
- All felled habitat trees should remain in place for a least one night to allow any remaining fauna to escape, and
- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.

### **5.2.2 Weed management**

Weed species could be inadvertently brought into the Development Footprint or surrounding habitats with imported materials or could invade naturally through removal of native vegetation. The presence of weed species has the potential to decrease the value of vegetation for native species, particularly threatened species.

Weed management controls will include:

- all machinery and equipment will be cleaned thoroughly prior to entering the Development Footprint. Cleaning must include the removal of all mud and plant matter, followed by washing with high pressure water.
- mulch containing weeds is to be placed in piles separate from clean mulch, removed from site, and disposed of in accordance with weed management guidelines as soon as practicable.

### **5.2.3 Fencing and access control**

During construction, fencing will be used to demarcate vegetation where required to avoid accidental damage to areas outside of the Development Footprint.

Access control is an important feature in protecting and demarcating areas outside the Development Footprint from vehicle access, human access, and accidental disturbance. Measures include:

- appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance and to minimise vehicular and human traffic
- clear and visible signage is to be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the Development Footprint and
- locking of gates to prevent unwanted vehicle, person access and disturbance.

## 5.2.4 Bushfire management

The vegetation that will be retained within areas adjoining of the Development Footprint will require appropriate bushfire management to protect life and property, while supporting appropriate conditions for the significant ecological features identified.

This will be achieved through the implementation of a range of measures, including:

- maintaining a suitably equipped response to any fires on site and assisting the Rural Fire Service and emergency services on site in the event of a fire
- maintaining Strategic Fire Advantage Zones (SFAZ), including strategically positioned fire breaks and access roads
- Partial clearing of APZs .

A Bushfire Assessment Report has been prepared for the project (BPA 2021) and outlines the required protection measures and management requirements. Whilst the report states that the APZs will be partially cleared (up to 15% canopy cover) and this represents a minimisation measure, the biodiversity calculator that underpins this BDAR has generated credit using a worst-case scenario which assumes complete clearance for all APZs.

## 5.2.5 Erosion and sediment control

A Stormwater Management Plan has been prepared to appropriately limit post development flows and manage downstream water quality as part of the SSDA for site establishment and clearing works.

Measures to be implemented include:

- minimising the area of disturbance
- diverting run-off water around disturbed areas
- installation and ongoing maintenance of erosion and sediment controls (e.g. sediment fencing) throughout the duration of the Project
- stabilisation (i.e. sealing, landscaping) of all disturbed areas to reduce the potential for future erosion.

## 5.2.6 Workforce education and training

The development of education packages and training can help to mitigate anthropogenic impacts on biodiversity. The ability of non-ecological personnel to identify key threatened species or key ecological threats can help to mitigate impacts on threatened species. The following mitigation actions will be implemented for the Project to develop a greater understanding and awareness of biodiversity issues in non-ecological trained personnel:

- Inductions for the workforce will be undertaken to make them aware of the key ecological issues present in the Development Footprint and so that they know their role and responsibilities in the protection and/or minimisation of impacts to all native biodiversity
- Inductions will identify the location of sensitive flora and fauna and the policies being implemented to protect the biodiversity values of such areas.

## 5.2.7 Summary of Measures, Timing and Responsibility

Management including the timing, action, outcome and responsibility of these measures.

**Table 5.1 Recommended Avoidance and Minimisation Measures**

Measure	Timing	Responsibility	Proposed Techniques	Outcome
<b>Before</b>				
<b>Workforce education and training</b>	Pre-construction and during construction	Site Manager	<ul style="list-style-type: none"> <li>Environmental induction</li> </ul>	<ul style="list-style-type: none"> <li>Environmental awareness for construction crews</li> </ul>
<b>During</b>				
<b>Implement Construction Environmental Management Plan</b>	Prior to clearance and during clearance activities	Site Manager	<ul style="list-style-type: none"> <li>Develop plan to adequately manage environmental impacts during construction including fencing and access control, weed management and erosion and sediment control</li> </ul>	<ul style="list-style-type: none"> <li>Minimal impacts to environmental values</li> </ul>
<b>Demarcation of approved clearance boundaries</b>	Prior to clearance and during clearance activities	Site Manager	<ul style="list-style-type: none"> <li>Clearly identify areas not proposed for clearance.</li> </ul>	<ul style="list-style-type: none"> <li>Minimisation of unnecessary impacts to surrounding vegetation and habitats.</li> </ul>
<b>Pre clearance and tree felling supervision</b>	Prior to clearance and during clearance activities	Project ecologist and site manager	<ul style="list-style-type: none"> <li>Pre- clearance and tree felling in accordance with <b>Section 5.2.1</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Minimal impacts to local fauna and their habitats</li> </ul>
<b>After</b>				
<b>Weed management</b>	Construction and operation	Site Manager	<ul style="list-style-type: none"> <li>Chemical and physical removal of invasive weed species in accordance with the <i>Noxious and Environmental Weeds Handbook</i> (DPI 2014).</li> <li>Regular inspection to identify potential weed infestations.</li> </ul>	<ul style="list-style-type: none"> <li>Minimisation of environmental and noxious weeds within the site</li> <li>Minimisation of weed spread from and into the wider locality.</li> </ul>
<b>Fencing and access control</b>	Construction and operation	Site Manager	<ul style="list-style-type: none"> <li>temporary fencing to manage access to existing tracks and paths during construction</li> </ul>	<ul style="list-style-type: none"> <li>Provides for access control to avoid unwanted human interference and disturbance to non-operational areas.</li> <li>Minimisation of impacts to native fauna species from avoiding the use of barbed-wire fences.</li> </ul>
<b>Erosion and sedimentation control</b>	Construction and operation	Site Manager	<ul style="list-style-type: none"> <li>Adequate controls during works for erosion and sediment control</li> </ul>	<ul style="list-style-type: none"> <li>Avoid sediment entering local creeks</li> </ul>

## 6.0 Assessment of Impacts

### 6.1 Direct Impacts

The development of the Project will result in direct impacts on biodiversity values within the Development Footprint. Direct impacts include the loss of native vegetation and fauna habitats as a result of clearance works. As discussed in **Section 1.7**, the Development Footprint excludes the construction footprint assessed by the Biodiversity Assessment Report for the RP2J Bypass project as these impacts have been approved under SSI application (SSI 6888) and biodiversity offsets for that impact are conditioned under that approval.

**Table 6.1** below outlines these impacts as they were entered into the BAM calculator, which totals approximately 7.8 ha of direct impacts to native vegetation communities.

Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Sections 5.1** and **5.2** above.

**Table 6.1 Direct Impacts of the Project on Native Biodiversity Features**

Ecological Feature	Area within the Development Footprint (ha)	Area that conforms to BC Act TEC	Area that Conforms to EPBC Act TEC
<b>Plant Community Type</b>			
<i>Condition</i>			
PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter <b>Moderate to Good</b>	2.3	2.3	-
PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands <b>Moderate to Good</b>	0.7	-	-
PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <b>Moderate to Good</b>	1.7	-	-
<b>Total</b>	<b>4.7</b>	<b>2.3</b>	<b>Nil-</b>
<b>Species-credit Species Habitats</b>			
black-eyed Susan <i>Tetratheca juncea</i>	0.44	N/A	N/A
squirrel glider <i>Petaurus norfolcensis</i>	4.7	N/A	N/A

## 6.2 Indirect Impacts

The Project is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding locality. However, some minor indirect impacts associated with habitat connectivity, fugitive light emissions, air quality, noise and weeds may occur during the construction of the Project. This is further discussed in the sections below in accordance with Section 9.1.4 of the BAM. Whilst Section 9.1.4 of the BAM identifies a range of potential indirect impacts to be considered, only those relevant to the Project are discussed below.

### 6.2.1 Connectivity and Corridors

The removal of native vegetation from within the Development Footprint will reduce the area currently used by local fauna species to move through the landscape. The vegetation in Jesmond Bushland Reserve forms part of a larger remnant patch which connects to several other reserves including Sygna Close Reserve, Dangerfield Drive Reserve, and the locally significant Blackbutt Reserve. The vegetation to be removed is on the edge of existing development and the Project will not sever or increase fragmentation of the existing reserve network of biodiversity connectivity pathways.

As such, the relative loss of connectivity and movement corridors for native flora and fauna as a result of the proposed Project is considered minor and unlikely to impede, beyond that already experienced, the movement of fauna species across the already fragmented landscape.

### 6.2.2 Fugitive light emissions

Fugitive light emissions resulting from the Project may result in adverse impacts on adjacent habitats and, particularly nocturnal birds and bats. Behavioural changes in animals can occur in response to the physical presence of a development and include changes in foraging locations and mating behaviour (Gleeson and Gleeson 2012). This may lead to changes in species composition in the landscape.

Research into the impacts of altered lighting indicates that it can trigger behavioural and physiological responses including changes in foraging behaviour, disruptions of seasonal day length trigger cues for critical behaviour, disorientation and temporary blindness and interference with predator prey relationships. Appropriate lighting controls to minimise impacts will be implemented as part of the Project including minimisation of fugitive lighting emissions following Australian Standards. There will be no substantial change to fugitive light emission impacts on the surrounding fauna habitat given that the proposed JHHIP will become a part of existing JHH operations with existing lighting impacts.

### 6.2.3 Noise impacts

Noise impacts have the potential to adversely impact native species. Potential impacts include:

- noise disturbing the roosting and foraging behaviour of fauna species
- noise reducing the occupancy of areas of otherwise suitable habitat.

Noise impacts can affect fauna physiology and behaviour, particularly by causing disruption to communication including mating calls, territorial calls, and alarm calls (Gleeson and Gleeson 2012).

There will be no substantial change to noise impacts on fauna given that the proposed JHHIP will become a part of existing JHH operations with existing noise impacts. Any additional impacts resulting from noise emissions are not expected to be substantial for threatened species, populations, and communities.

## 6.2.4 Air quality impacts

Air quality impacts have the potential to adversely impact native species from dust generating activities during ground disturbing works. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth and increased air pollutants for native species (flora and fauna) making them more susceptible to environmental stresses.

The construction of the Project will include inherent measures to minimise the potential for adverse air quality impacts however additional controls, such as the use of a water truck to suppress dust created by construction works will be implemented where required.

Any additional air quality impacts are not expected to be of any level of significance in relation to threatened species, populations, and communities.

## 6.2.5 Weed encroachment

Weed species could be inadvertently brought into the Development Footprint with imported materials and could invade adjoining remnant vegetation. The introduction of weed species has the potential to decrease the biodiversity value of extant vegetation through competition with native species, particularly threatened species and as such weed encroachment and invasion represents a potential indirect impact.

Weed management measures to minimise the potential for weed encroachment into areas surrounding the Development Footprint are provided in **Section 5.2.2** and will effectively manage the risks during construction activities. Therefore, any additional impacts resulting from weeds are not expected to be of any level of significance in relation to threatened species, populations, and communities.

## 6.2.6 Mitigation and onsite management of indirect impacts

Section 8.0 of the BAM relates to onsite avoidance and minimisation measures required for consideration for impacts related to the operational phase of the Project. **Section 5.2** outlines the mitigation measures proposed for the Project for direct and indirect impacts including:

- implementation of clearing procedures to minimise the impacts of the clearing process and maximise the recovery of any valuable biodiversity resources (e.g. re-use of hollow logs and hollows where appropriate)
- high-threat weed control
- fencing and access control
- bushfire management
- erosion and sediment control
- workforce education and training.

Should the Project be approved, a Biodiversity Management Plan will be developed by the construction contractors as part of the Construction Environmental Management Plan to ensure these measures are adhered to during the construction of the Project.

## 6.3 Prescribed Impacts

Prescribed impacts have been considered for the entire Study Area. The following impacts are considered 'prescribed impacts' under the BC Regulation:

- impacts on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation.
- impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- impacts on movement of threatened species that maintains their life cycle
- impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- impacts of wind turbine strikes on protected animals
- impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

The Project will not involve impacts related to wind farms, substantial changes to vehicle strike risk, or on karst ecosystems.

Important connectivity and movement habitat are unlikely to be impacted by the Project (refer to **Section 6.2.1**).

Groundwater dependent ecosystems (GDEs), hydrology and environmental flows are unlikely to be impacted by the Project due to the implementation of measures outline in **Section 5.2.5**.

## 6.4 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles prescribed in the BC Regulation. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in NSW. These are impacts that:

- will cause a further decline of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to be in a rapid rate of decline, or
- will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size, or
- impact on the habitat of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very limited geographic distribution, or
- impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

A total of 21 species-credit species predicted by the BAM calculator or according to the literature for this Project are listed as potential serious and irreversible impact (SAII) entities in the TBDC (DPIE 2020c). Reasons for listing in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (DPIE 2019b) and DPIE Threatened Species Profiles are shown in **Table 6.2** below:

**Table 6.2 Likelihood of impacts to SAI entities**

Species	Reason for Listing	Likelihood of Impact
<b>Flora</b>		
thick-leaf star-hair ( <i>Astrotricha crassifolia</i> )	Number of mature individuals is very low. Geographic distribution is very highly restricted. Reproductive strategy severely limits recruitment – sterile or primarily clonal.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
thick lip spider orchid ( <i>Caladenia tessellata</i> )	The species is experiencing a high rate of decline. Geographic distribution is very highly restricted.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
<i>Corunastylis</i> sp. Charmhaven (NSW896673)	The estimated total number of mature individuals of the species is very low. The species is experiencing a high rate of decline. Geographic distribution is very highly restricted.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
<i>Diuris bracteata</i>	Geographic distribution is very highly restricted. Number of mature individuals is extremely low.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
<i>Euphrasia arguata</i>	The geographic distribution of the species is estimated or inferred to be very highly restricted, and a projected or continuing decline is observed, estimated, or inferred.	This species was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
variable midge orchid ( <i>Genoplesium insigne</i> )	Number of mature individuals is very low. Geographic distribution is very highly restricted.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
<i>Grevillea shiressii</i>	Geographic distribution is very highly restricted.	This species was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.

Species	Reason for Listing	Likelihood of Impact
eastern underground orchid ( <i>Rhizanthella slateri</i> )	Number of mature individuals is very low.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
scrub turpentine ( <i>Rhodamnia rubescens</i> )	Decline in health/loss of mature plants and a lack of seed based recruitment due to infection by <i>Austropuccinia psidii</i> (myrtle rust). Ongoing degradation of habitat.	This species was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
native guava ( <i>Rhodomyrtus psidioides</i> )	Decline in health/loss of mature plants and a lack of seed based recruitment due to infection by <i>Austropuccinia psidii</i> (myrtle rust). Ongoing degradation of habitat.	This species was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
<b>Fauna</b>		
regent honeyeater ( <i>Anthochaera phrygia</i> )	The species has undergone, is observed, estimated, inferred, or reasonably suspected to have undergone or is likely to undergo a very large reduction in population size.	The Development Footprint does not occur in the area mapped as “important habitat” and the species has not been recorded in the Development Footprint. The Project is not expected to result in a serious and irreversible impact on this species.
large-eared pied bat ( <i>Chalinolobus dwyeri</i> )	Species dependent on non-responding attribute (maternity caves). This species is considered unlikely to respond to management.	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in <b>Figure 3.1</b> , extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and ecologists with more than 10 years experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. The Project is not expected to result in a serious and irreversible impact on this species.

Species	Reason for Listing	Likelihood of Impact
<p>red goshawk (<i>Erythrotriorchis radiatus</i>)</p>	<p>The species has undergone, is observed, estimated, inferred, or reasonably suspected to have undergone or is likely to undergo a very large reduction in population size.</p>	<p>This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive surveys.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>
<p>swift parrot (<i>Lathamus discolor</i>)</p>	<p>Numbers have been reduced to such a critical level and habitats have been so drastically reduced that the species is in immediate danger of extinction.</p>	<p>The Development Footprint does not occur in the area mapped as “important habitat” and the species has not been recorded in the Development Footprint.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>
<p>little bent-winged bat (<i>Miniopterus australis</i>)</p>	<p>The species is dependent on non-responding attribute (breeding habitat only). This species is considered unlikely to respond to management.</p>	<p>As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only.</p> <p>While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in <b>Figure 3.1</b>, extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and an ecologist with more than 10 years’ experience.</p> <p>As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>

Species	Reason for Listing	Likelihood of Impact
<p>large bent-winged bat (<i>Miniopterus orianae oceanensis</i>)</p>	<p>The species is dependent on non-responding attribute (breeding habitat only). This species is considered unlikely to respond to management.</p>	<p>As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only.</p> <p>While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in <b>Figure 3.1</b>, extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and an ecologist with more than 10 years' experience.</p> <p>As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>
<p>stuttering frog (<i>Mixophyes balbus</i>)</p>	<p>Threats beyond control (key threat chytrid fungus).</p>	<p>This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive surveys.</p> <p>Suitable habitat, hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features (DPIE 2020c), is not present within the Development Footprint.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>
<p>brush-tailed rock-wallaby (<i>Petrogale penicillata</i>)</p>	<p>Species dependent on non-responding attribute (rocky habitat).</p>	<p>This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive surveys.</p> <p>Suitable habitat, land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliffines (DPIE 2020c), is not present within the Development Footprint.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>
<p>golden sun moth (<i>Synemon plana</i>)</p>	<p>There is evidence of a decline from a previous wider distribution, a decline in available habitat and continuing threats to habitat.</p>	<p>This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive surveys.</p> <p>Suitable habitat, grassland dominated by wallaby grass (<i>Rytidosperma</i> sp.), Chilean needlegrass (<i>Nassella nessiana</i>) or serrated tussock (<i>Nassella trichotoma</i>) (DPIE 2020c), is not present within the Development Footprint.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>

Species	Reason for Listing	Likelihood of Impact
sooty owl ( <i>Tyto tenebricosa</i> )	Species dependent on non-responding attribute (cave breeding habitat only).	<p>While the Development Footprint may contain foraging habitat for this species, no evidence of breeding was recorded within the Development Footprint despite extensive surveys.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>
eastern cave bat ( <i>Vespadelus troughtoni</i> )	<p>Species dependent on non-responding attribute (cave breeding habitat only).</p> <p>This species is considered unlikely to respond to management.</p>	<p>As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. Potential habitat for this species is defined as rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.</p> <p>While the Development Footprint may contain foraging habitat for this species, no rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds are present or, based on API, located within 100m of the Development Footprint. As shown in <b>Figure 3.1</b>, extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and an ecologist with more than 10 years' experience.</p> <p>As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.</p> <p>The Project is not expected to result in a serious and irreversible impact on this species.</p>

For the reasons discussed above, the Project is not expected to have an impact that is serious and irreversible.

## 7.0 Impact Summary

### 7.1 Impacts not requiring assessment

Impacts not requiring further assessment under the BAM include areas of land without native vegetation. The Development Footprint contains approximately 4.7 ha of cleared land/non-native vegetation that will be removed as a result of the project. This impact does not require further assessment under the BAM.

### 7.2 Impacts not requiring offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is not associated with ecosystem-credit habitat or a VEC) or less than 15 (where it is representative of a EEC or CEEC).

No vegetation zone identified within the Development Footprint has a vegetation integrity score lower than 17 and as such, all areas of native vegetation impacted will require offsetting.

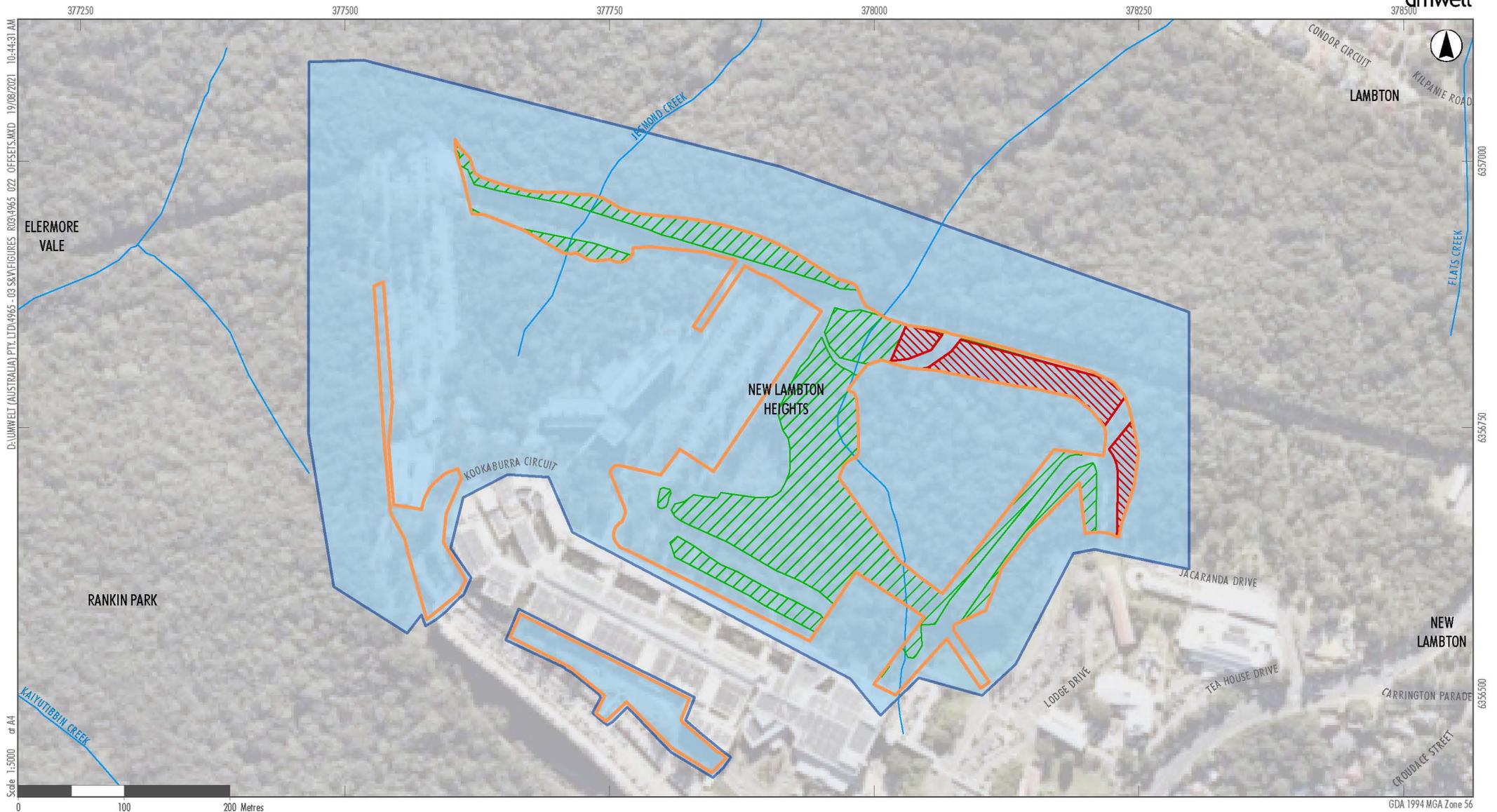
### 7.3 Impacts requiring offset

**Table 7.1** summarises the offsetting requirements for PCTs and species-credit species habitat impacted by the Project as calculated in accordance with the BAM (refer to **Figure 7.1**). As shown in **Figure 7.1**, the development, including north road network, will be delivered as part of a phased development. The initial phase will enable the project to meet timelines for the ASB to be operational and provide critical health services for the region. The later “North Road – East Phase” completes the campus wide infrastructure setting up the delivery of the future precinct vision. As such, we have documented the credits for each phase separately to enable the offsets to be delivered in a phased manner consistent with the project progress.

**Table 7.1 Impacts requiring offset**

Vegetation Zone	PCT/Species-credit	Area (ha)	Vegetation Integrity Score		
			Current	Future	Change
<b>Phase 1</b>					
<b>1</b>	PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter <i>Moderate to Good</i>	2.3	59.8	0	-59.8
<b>2</b>	PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands <i>Moderate to Good</i>	0.7	48	0	-48
<b>3</b>	PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Moderate to Good</i>	0.9	54.4	0	-54.4

Vegetation Zone	PCT/Species-credit	Area (ha)	Vegetation Integrity Score		
			Current	Future	Change
-	black-eyed Susan <i>Tetratheca juncea</i>	0.44	N/A	N/A	N/A
-	squirrel glider <i>Petaurus norfolcensis</i>	3.9	N/A	N/A	N/A
<b>Phase 2</b>					
<b>3</b>	PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Moderate to Good</i>	0.8	54.4	0	-54.4
-	squirrel glider <i>Petaurus norfolcensis</i>	0.8	N/A	N/A	N/A



- Legend
- Study Area
  - Biodiversity Assessment Area (Development Footprint)
  - Areas Requiring Offset - Phase 1
  - Areas Requiring Offset - Phase 2
  - Drainage Line

FIGURE 7.1  
Impacts Requiring Offset

## 8.0 Biodiversity Credit Report

The full Biodiversity Credit Report is included in **Appendix F**. In addition, credit reports for Phase 1 and Phase 2 are also provided in **Appendix F**

**Table 8.1** below provides a summary of the ecosystem and species credits and their credit classes. The credit classes outlined in **Table 8.1** identify the types of offsets that can be used to meet an offset obligation under the Biodiversity Offsets Scheme ('Like for Like' Rules).

**Table 8.1 Ecosystem and Species Credits Generated at the Study Area**

Name	Credit Class	Credits Generated
<b>Phase 1</b>		
PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	Any PCT in the <i>Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions</i> EEC in the Wyong IBRA subregion:	69
PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group	13
PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group	19
black-eyed Susan <i>Tetratheca juncea</i>	N/A	11
squirrel glider <i>Petaurus norfolcensis</i>	N/A	111
<b>Phase 2</b>		
PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group	16
squirrel glider <i>Petaurus norfolcensis</i>	N/A	21

## 9.0 Biodiversity Offset Strategy

The Project is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project.

As discussed in **Section 7.3**, The Project includes a phased offsetting approach and the following credits to be retired for each phase.

**Table 9.1 Credits to be Retired for Each Phase**

Credits Type	Phase 1	Phase 2	Total
PCT 1592	69		69
PCT 1619	13		13
PCT 1627	19	16	35
Black-eyed Susan ( <i>Tetradlea juncea</i> )	11		11
Squirrel glider ( <i>Petaurus norfolcensis</i> )	111	21	132

As discussed in **Section 5.0**, The Project Team has, where possible, altered the design to avoid and minimise ecological impacts in the Project planning stage, and a range of impact mitigation strategies have been outlined. The offset requirements for the Project, as calculated in accordance with the BAM are identified in **Section 8.0**.

The offset strategy will be implemented in consideration of the process outlined in the BC Act, and the final composition of the offset strategy may evolve as the Project progresses. The biodiversity offset strategy will be developed during the assessment process in consultation with the BCD and DPIE and based on the credits required to be retired to offset the impacts of the Project as specified in **Table 8.1**.

The current intention is to relinquish the credit obligation through either:

- purchasing credits from the market (if they are available during the timeframe conditioned in the consent), and/or
- making a contribution into the Biodiversity Conservation Fund.

## 10.0 References

Botanic Gardens Trust, (2019) *PlantNET* – The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (version 2.0). Accessed September 2019.

Bureau of Meteorology (2020) Climate Data Online – Newcastle University (061390). Accessed September 2020.

Bushfire Planning Australia (2020) John Hunter Hospital Innovation Precinct Bushfire Risk Assessment.

Cronquist, A, (1981) *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York. Department of the Environment (2013) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance.

Department of Agriculture, Water and the Environment (DAWE) (2020) Protected Matters Search Tool. Accessed September 2020.

Department of Environment and Climate Change (DECC) (2008) Descriptions for NSW (Mitchell) Landscapes *Version 3*.

Department of Environment and Conservation (DEC) (2004) *Threatened Species Survey and Assessment: Guidelines for development and activities (working draft)*, November 2004.

Department of Planning, Industry and Environment (DPIE) (2012) Ramsar Wetlands of NSW Mapping, April 2012.

Department of Planning, Industry and Environment (DPIE) (2019a) Biodiversity Assessment Method Operational Manual – Stage 2, September 2019.

Department of Planning, Industry and Environment (DPIE) (2019b) *Guidance To Assist A Decisionmaker To Determine A Serious And Irreversible Impact*, September 2019.

Department of Planning, Industry and Environment (DPIE) (2020a) eSPADE NSW Soil and Land Information. Accessed September 2020.

Department of Planning, Industry and Environment (DPIE) (2020b) BioNet Atlas of NSW Wildlife. Accessed September 2020.

Department of Planning, Industry and Environment (DPIE) (2020c) Threatened Biodiversity Data Collection (TBDC). Accessed September 2020.

Department of Planning, Industry and Environment (DPIE) (2020d) VIS Classification Database. Accessed September 2020.

Department of Primary Industries (DPI 2020) Seasonal Conditions Information Portal. Accessed September 2020.

GHD (2018) Newcastle Inner City Bypass, Rankin Park to Jesmond Biodiversity Assessment Report.

Gleeson, J and Gleeson, D (Eds) (2012) *Reducing the impacts of development on wildlife*. CSIRO Publishing, Melbourne.

Harden, G, J, editor, (1992) *Flora of New South Wales. Volume 3*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Harden, G, J, editor, (1993) *Flora of New South Wales. Volume 4*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Harden, G, J, editor, (2000) *Flora of New South Wales. Volume 1*. 2<sup>nd</sup> edition. New South Wales University Press and Royal Botanic Gardens, Sydney.

Harden, G, J, editor, (2002) *Flora of New South Wales. Volume 2*. Revised edition. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

NSW Threatened Species Scientific Committee (NSW TSSC) (2019) Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions – Final Determination. 31 May 2019.

Office of Environment and Heritage (OEH) (2017) Biodiversity Assessment Method.

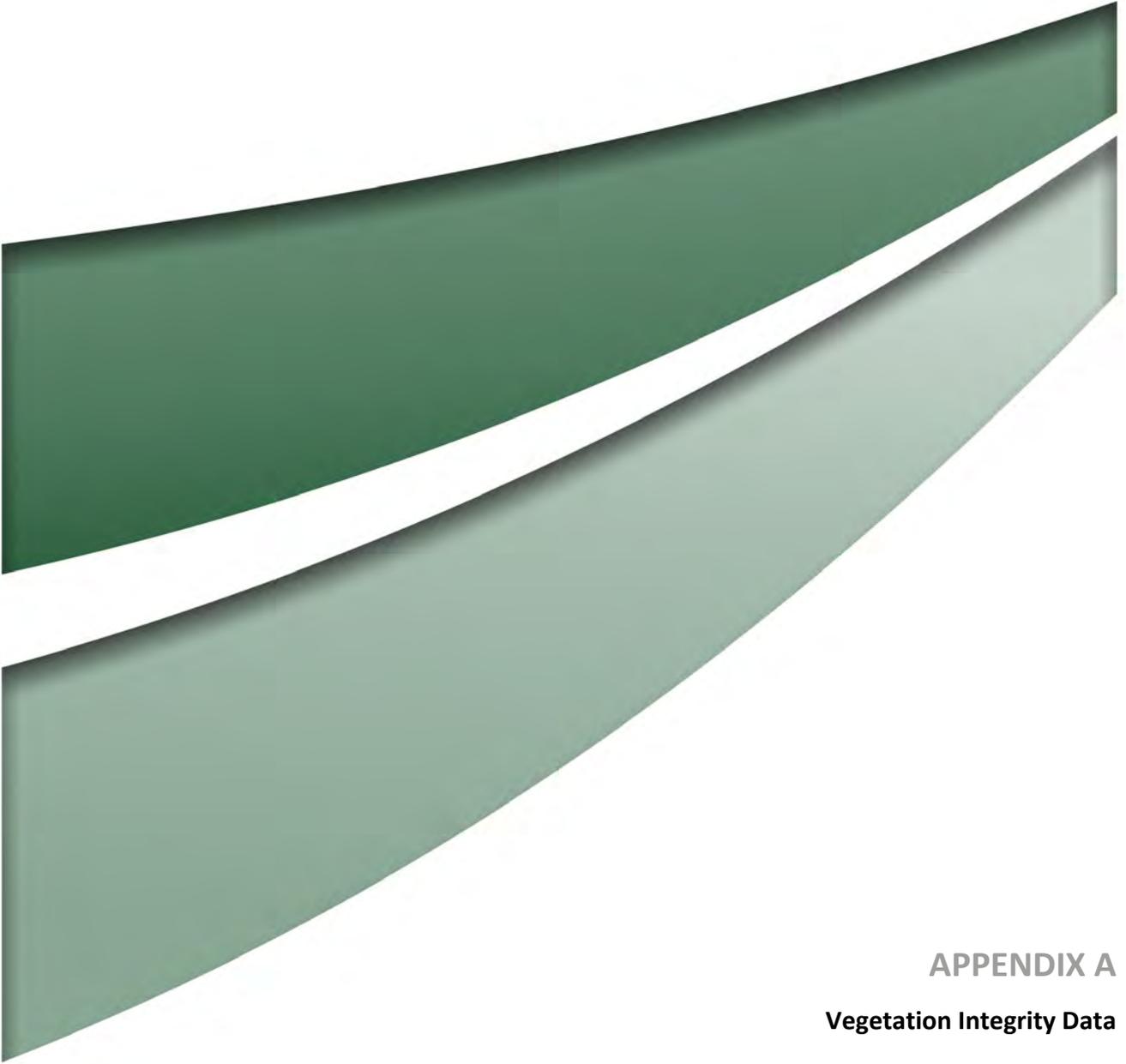
Office of Environment and Heritage (OEH) (2018) Biodiversity Assessment Method Operational Manual – Stage 1, May 2018.

Parsons Brinckerhoff (2014) Newcastle Inner City Bypass, Rankin Park to Jesmond Preliminary Environmental Investigation.

Strahler, A. N., (1952) Hypsometric (area-altitude) analysis of erosional topography, *Geological Society of America Bulletin* 63 (11): 1117-1142.

Threatened Species Profile Database (TSPD) (2020) Accessed September 2020.

Umwelt Environmental Consultants (Umwelt) (2006) Ecological Constraints for a Proposed New Route for State Highway 23 between Rankin Park and Jesmond. An unpublished Report prepared for the Roads and Traffic Authority. February 2006.



**APPENDIX A**  
**Vegetation Integrity Data**

## Vegetation Integrity Data

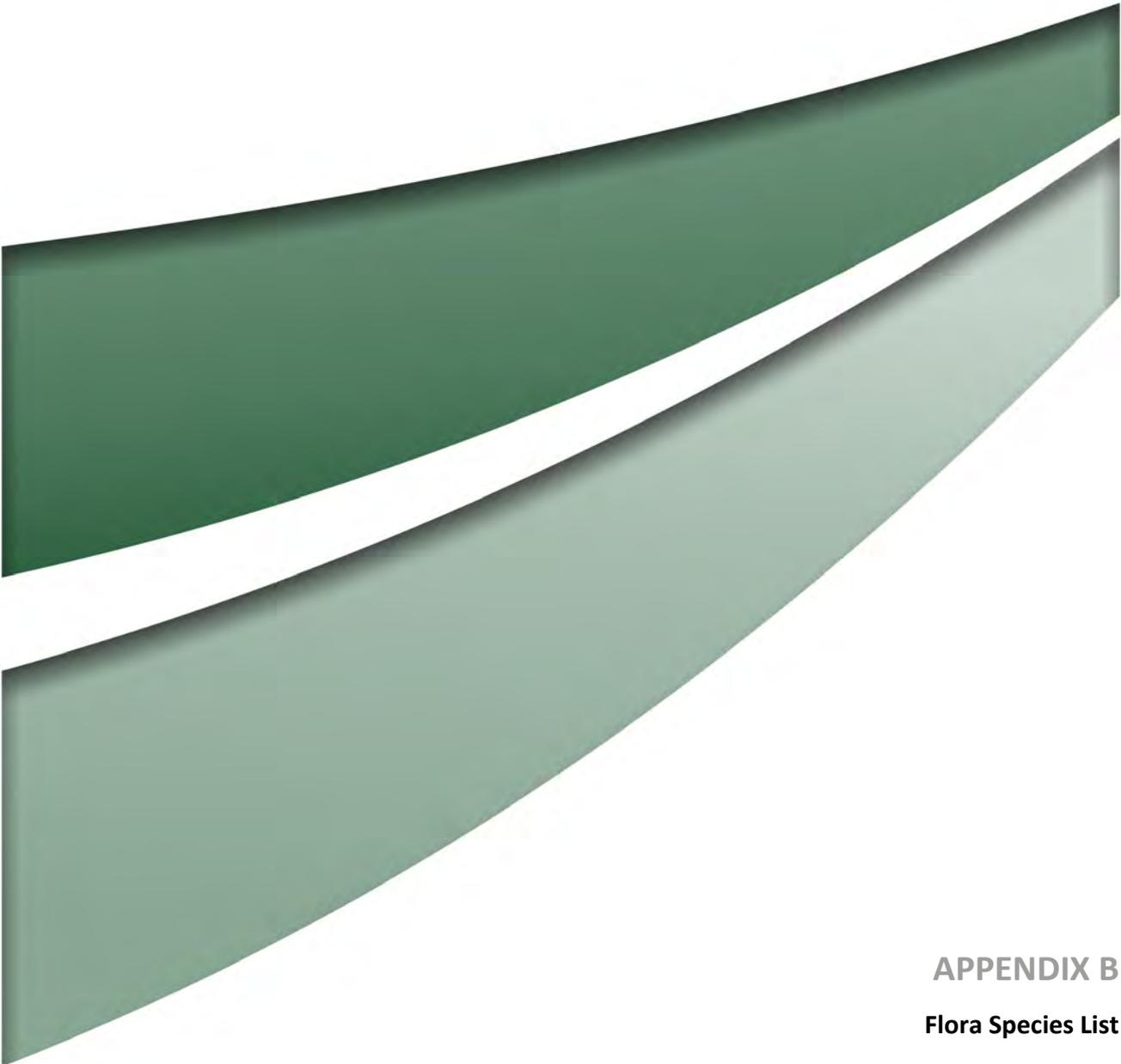
The following vegetation integrity data was collected from surveys of the Study Area. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM-C to assess the condition of each PCT in the Site.

The following abbreviations are used in the table below:

Tr	Tree (growth form)
Sh	Shrub (growth form)
Gr	Grass (growth form)
Fb	Forb (growth form)
Fn	Fern (growth form)
Ot	Other (growth form)

**Table A-1 Vegetation Integrity Data**

Plot Name	COMPOSITION						STRUCTURE						FUNCTION												
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds		
													>5	5-10	10-20	20-30	30-50	50-80							
<i>Veg Zone 1 – PCT 1592 – Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter – Moderate to Good</i>																									
Q02	5	6	7	5	0	1	30.1	65.5	0.9	0.5	0.0	0.1	1	1	1	1	1	1	1	1	1	1	66.0	27.0	0.0
Q03	5	7	6	3	0	3	55.1	53.2	0.6	0.4	0.0	0.3	1	1	1	1	1	1	1	1	1	86.0	43.0	0.0	
<i>Veg Zone 2 – PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands – Moderate to Good</i>																									
Q04	3	9	6	3	1	2	31.0	6.0	21.7	5.2	0.2	1.2	1	1	1	1	1	1	1	0	1	26.0	4.0	0.0	
Q05	5	9	8	4	0	3	35.2	17.9	32.5	0.5	0	0.3	1	1	1	1	1	1	1	1	1	44.0	21.0	0.0	
<i>Veg Zone 3 – PCT 1627– Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast – Moderate to Good</i>																									
Q01	4	12	8	5	2	3	31.0	7.4	0.9	0.6	0.2	0.4	1	1	1	1	1	1	1	1	2	53.0	29.0	0.0	
Q06	5	12	5	3	2	5	37	33.0	11	1.3	2.1	1.4	1	1	1	1	1	1	1	0	30.0	24.0	0.0		



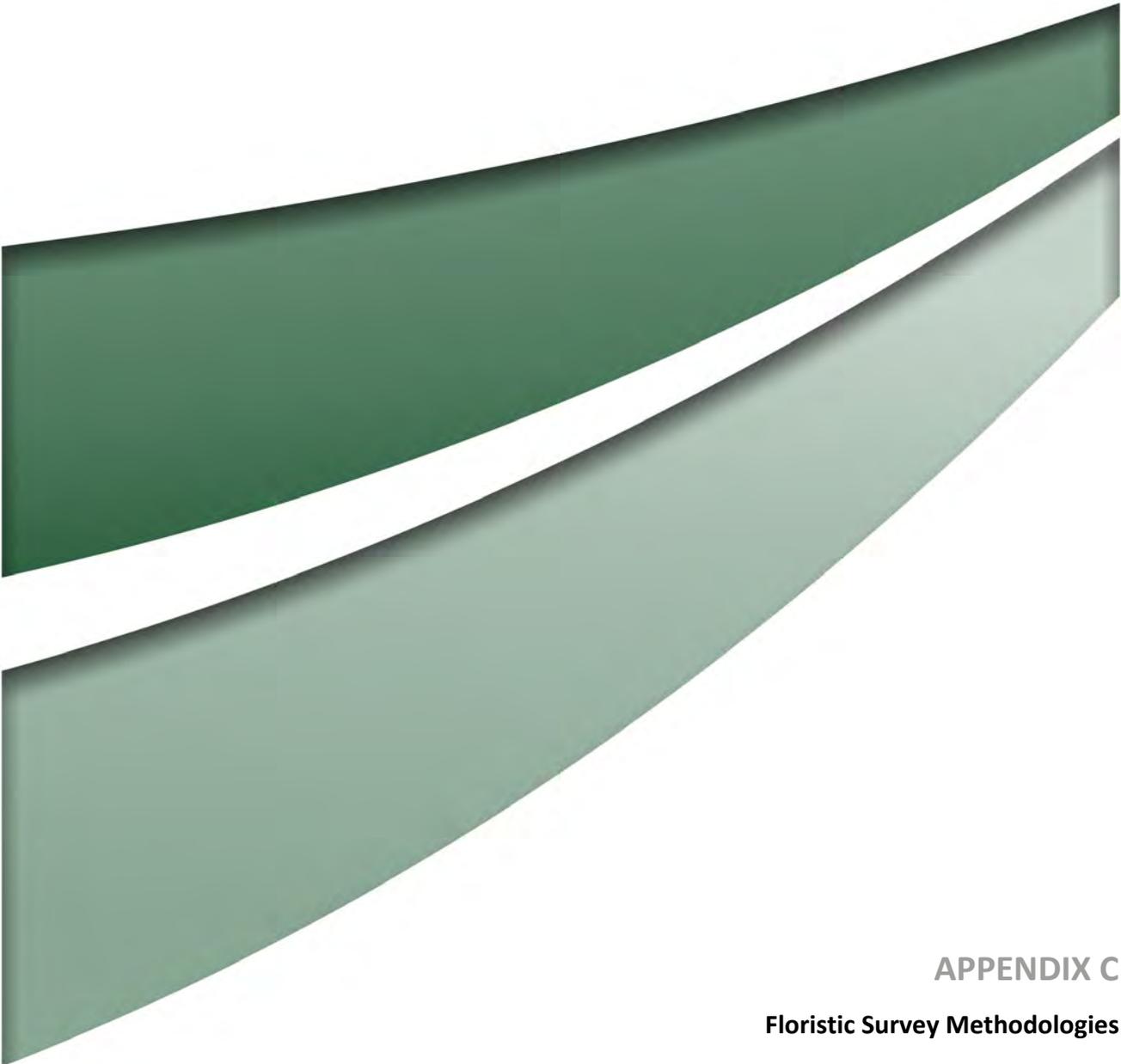
**APPENDIX B**  
**Flora Species List**



**Table B-1 Flora Species List**

Scientific Name	Common name	Veg Zone 1 – PCT 1592 Moderate to Good				Zone 2 – PCT 1619 Moderate to Good				Zone 3 – PCT 1627 Moderate to Good			
		Q02		Q03		Q04		Q05		Q01		Q06	
		C	A	C	A	C	A	C	A	C	A	C	A
<i>Acacia longifolia</i>										0.2	5	1	5
<i>Acacia terminalis</i>	sunshine wattle	5	200	10	100	0.5	1			0.2	5		
<i>Acacia ulicifolia</i>	prickly Moses	0.2	100	1	100			0.1	10	5	200	5	200
<i>Acianthus fornicatus</i>	pixie caps	0.1	5										
<i>Adiantum hispidulum</i>	Rough maidenhair fern											0.1	10
<i>Allocasuarina</i> sp.		0.1	2	0.1	3					1	2	5	5
<i>Angophora costata</i>	smooth-barked apple	5	1			10	6	20	10	10	30	10	5
<i>Banksia spinulosa</i>	hairpin banksia					2	20						
<i>Banksia spinulosa</i> var. <i>collina</i>	hairpin banksia							10	50	0.1	1		
<i>Billardiera scandens</i>	hairy apple berry											0.1	10
<i>Bursaria spinosa</i>	blackthorn									0.1	10	0.1	10
<i>Caladenia catenata</i>	white caladenia	0.1	2										
<i>Calochilus</i> sp.	a beard orchid					0.1	1	0.1	2				
<i>Cassytha glabella</i>	devils twine							0.1	10				
<i>Corymbia gummifera</i>	red bloodwood					20	9	10	10				
<i>Corymbia maculata</i>	spotted gum	10	2	30	50								
<i>Daviesia squarrosa</i>								0.1	2				
<i>Daviesia ulicifolia</i>	gorse bitter pea							5	200	0.1	5		
<i>Denhamia silvestris</i>	narrow-leaved orangebark			1	10								
<i>Dianella caerulea</i> var. <i>producta</i>	blue flax-lily	0.1	10	0.1	20	0.1	50	0.2	50	0.1	10	1	50
<i>Dipodium variegatum</i>												0.1	1
<i>Dodonaea triquetra</i>	large-leaf hop-bush	60	1000	40	500			1	100	0.1	10	20	500
<i>Entolasia stricta</i>	wiry panic	0.1	50	0.1	200	0.5	1000	5	1000	0.2	1000	5	2000
<i>Epacris microphylla</i>	coast coral heath	0.1	20							0.1	10	0.1	10
<i>Epacris pulchella</i>	wallum heath					0.1	100						
<i>Eragrostis</i> sp.										0.1	5		
<i>Eucalyptus fibrosa</i>	red ironbark	10	2	10	3								
<i>Eucalyptus piperita</i>	Sydney peppermint							5	5	10	2	20	10
<i>Eucalyptus propinqua</i>	small-fruited grey gum			10	2							1	1
<i>Eucalyptus umbra</i>	broad-leaved white mahogany	5	1	5	1	1	1			10	2	1	1
<i>Gahnia clarkei</i>	tall saw-sedge	0.2	20										
<i>Glochidion ferdinandi</i>	cheese tree							0.1	1				
<i>Glycine clandestina</i>	twining glycine	0.1	5	0.1	20			0.1	10	0.1	20	0.1	1
<i>Gonocarpus tetragynus</i>		0.1	10	0.2	50			0.1	20	0.1	1	0.2	50
<i>Gonocarpus teucroides</i>	raspwort			0.1	2								
<i>Hardenbergia violacea</i>	purple coral pea			0.1	20					0.2	100		
<i>Hibbertia aspera</i>	rough guinea flower			0.1	3			0.1	5			0.1	10
<i>Hibbertia scandens</i>	climbing guinea flower							0.1	5				
<i>Hovea linearis</i>						5	500			0.2	500		
<i>Imperata cylindrica</i>	blady grass	0.2	50	0.1	50			0.2	50	0.1	50	1	20

Scientific Name	Common name	Veg Zone 1 – PCT 1592 Moderate to Good				Zone 2 – PCT 1619 Moderate to Good				Zone 3 – PCT 1627 Moderate to Good			
		Q02		Q03		Q04		Q05		Q01		Q06	
		C	A	C	A	C	A	C	A	C	A	C	A
<i>Indigofera australis</i>	Australian indigo					0.1	1						
<i>Kennedia rubicunda</i>	dusky coral pea											0.1	2
<i>Lepidosperma laterale</i>						0.1	200	1	20	0.1	10		
<i>Leptospermum</i> sp.	a tea tree					0.2	1	5	50			5	20
<i>Leucopogon lanceolatus</i>				0.1	1								
<i>Lindsaea linearis</i>	screw fern					0.2	100			0.1	1		
<i>Lobelia purpurascens</i>	whiteroot									0.1	200		
<i>Lomandra filiformis</i>	wattle mat-rush									0.1	10		
<i>Lomandra longifolia</i>	spiny-headed mat-rush	0.1	1	0.1	1							1	20
<i>Lomandra multiflora</i>	many-flowered mat-rush	0.1	20	0.1	20			0.2	20				
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush					0.1	75						
<i>Lomandra obliqua</i>						10	1000			0.1	50		
<i>Macrozamia flexuosa</i>						0.2	1						
<i>Mirbelia rubiifolia</i>								0.5	100			0.5	50
<i>Pandorea pandorana</i>	wonga vine			0.1	1							0.1	1
<i>Persoonia linearis</i>	narrow leaved geebung											0.1	1
<i>Phyllanthus hirtellus</i>	thyme spurge	0.1	50			2	100						
<i>Pimelea linifolia</i>	slender rice flower					0.1	25			0.2	50	0.1	10
<i>Pittosporum undulatum</i>	sweet pittosporum					0.5	1						
<i>Podolobium ilicifolium</i>	prickly shaggy pea							0.1	10	0.1	5	0.1	10
<i>Polyscias sambucifolia</i>	elderberry panax									0.1	3	1	10
<i>Pseuderanthemum variabile</i>	pastel flower	0.1	20					0.1	50	0.1	200		
<i>Pteridium esculentum</i>	common bracken									0.1	10	2	50
<i>Pultenaea paleacea</i>	chaffy bush-pea	0.1	20	1	50	0.5	75	1	50				
<i>Pultenaea</i> sp.										0.2	100		
<i>Rytidosperma pallidum</i>	silvertop wallaby grass	0.1	50	0.1	200	1	1000	20	1000	0.1	100	2	100
<i>Syncarpia glomulifera</i>	turpentine							0.1	1				
<i>Themeda triandra</i>	kangaroo grass	0.1	50	0.1	200	10	1000	1	500	0.1	100	2	100
<i>Xanthorrhoea latifolia</i>										0.1	1		
<i>Xanthorrhoea</i> sp.						1	10					1	20



**APPENDIX C**

**Floristic Survey Methodologies**

### **Floristic and Vegetation Integrity Survey**

This involved setting out a 20 x 20 metre plot and a 20 x 50 metre plot with a 50 metre transect. The location of each quadrat was recorded using a hand-held GPS with accuracy of  $\pm 5$  metres. The Map Grid of Australia (MGA) coordinate system was used.

At each plot, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 metre plot. Searches of each 20 x 20 metre plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which consistently supported well over half of the species present. Effort was made to search the tree canopy and tree trunks for mistletoes, vines, and epiphytes.

For each flora species recorded in the plot, the following data was collected in accordance with BAM guidelines (OEH 2017a):

- scientific name and common name of the species
- whether the species is native, exotic, or high threat exotic
- the growth form to which the species belongs
- cover and abundance of the species.

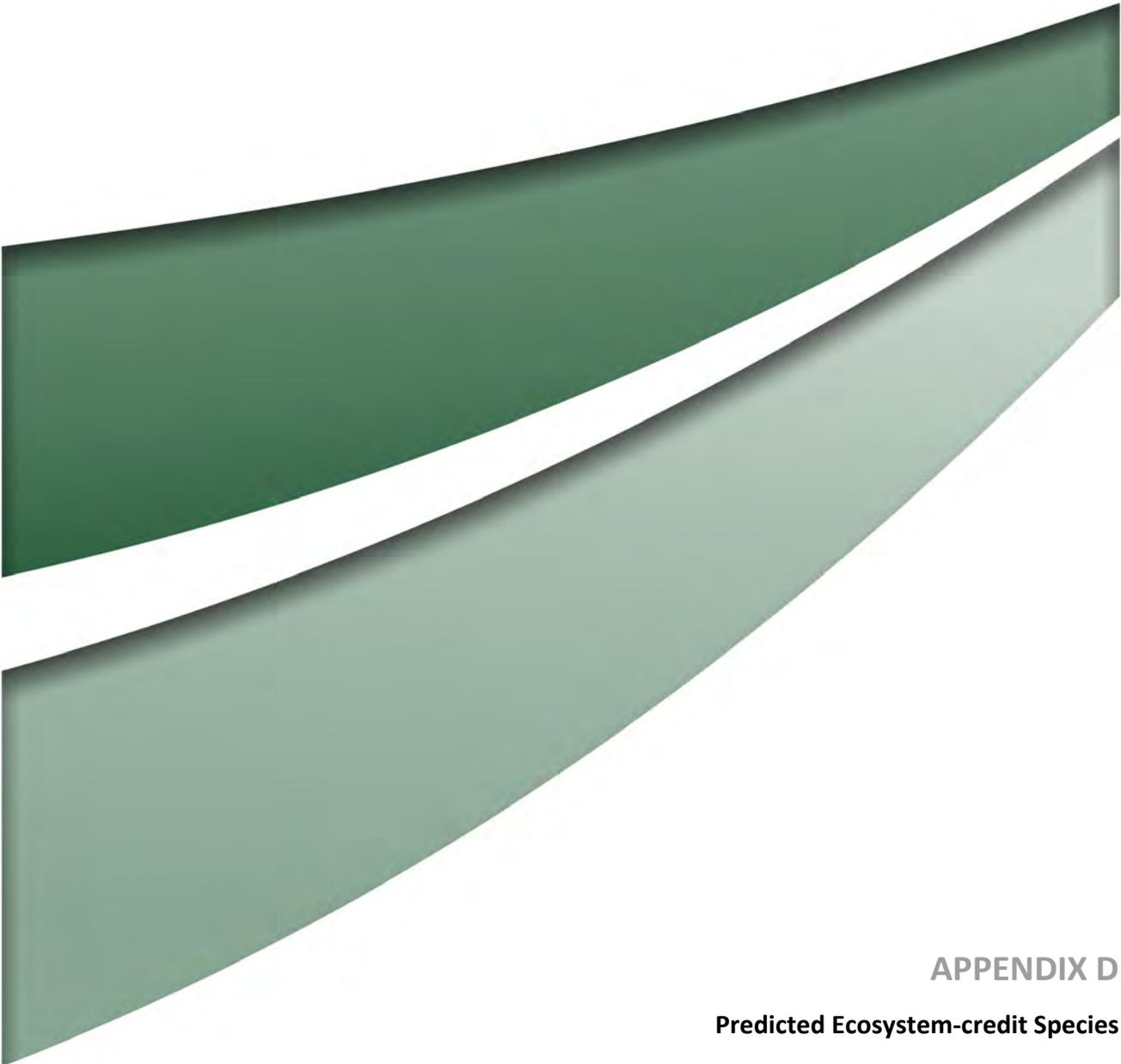
At each vegetation integrity plot the following attributes were recorded in accordance with the BAM (OEH 2017a) to determine the condition of the vegetation zone:

- **Composition** - native plant species richness by growth form (within the 20 x 20 metre plot)
- **Structure** – estimate foliage cover of native and exotic species by growth form (within the 20 x 20 metre plot)
- **Function** (within the 20 x 50 metre plot) including, number of large trees, presence or otherwise of tree stem size classes, presence or otherwise of canopy species regeneration, length of fallen logs, percentage cover for litter (recorded from five 1 x 1 metre plots), number of trees with hollows and high threat exotic cover.

### **Meandering Transects**

Meandering transects were undertaken through vegetation units across much of the Study Area, particularly for the delineation and refinement of vegetation mapping and searching for threatened and otherwise significant species, endangered populations and TECs. Meandering transects enabled floristic sampling across a much larger area than systematic plots, allowing the survey to achieve a combination of detailed observation and broader appreciation. Records along transects supplemented floristic sampling carried out as part of plot survey, however, the data collected was in the form of presence records. Where meandering transects revealed significant variation within a vegetation unit, or a potential new vegetation community, additional plot survey was undertaken.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Study Area.



**APPENDIX D**

**Predicted Ecosystem-credit Species**

**Table D-1** identifies the candidate ecosystem-credit species predicted by the BAM calculator or identified in the literature review, and documents recorded presence/absence from surveys undertaken within the Development Footprint. Marine, pelagic and wetland fauna species have been excluded due to lack of suitable habitat in the Development Footprint.

**Table D-1 Ecosystem-credit Species Occurrence**

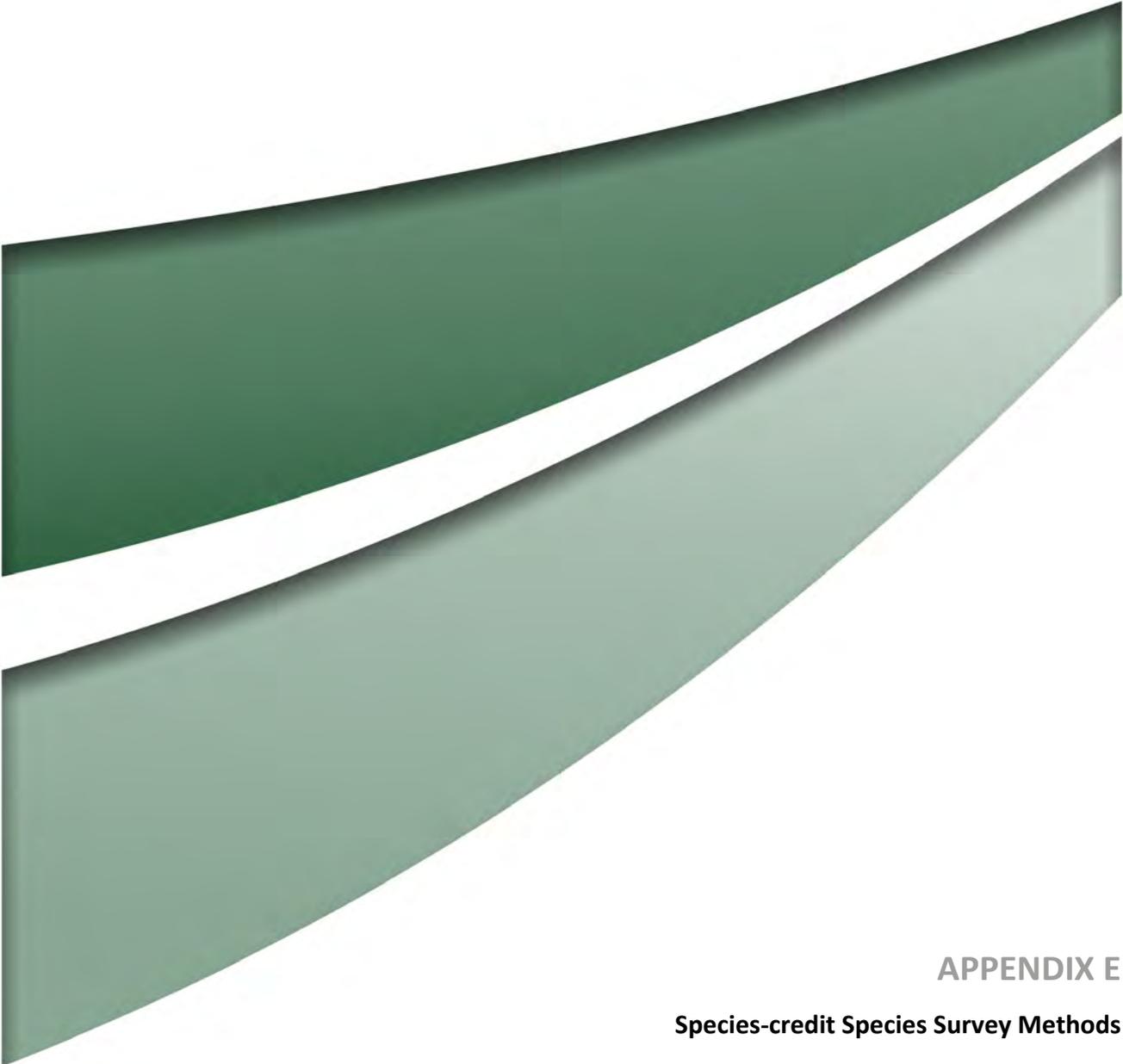
Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
regent honeyeater <i>Anthochaera phrygia</i>	CE	CE	No	No	-
fork-tailed swift <i>Apus pacificus</i>	-	C, J, K	No	No	-
dusky woodswallow <i>Artamus cyanopterus</i>	V	-	No	No	-
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V	-	No	No	All zones
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V	-	No	No	All zones
speckled warbler <i>Chthonicola sagittata</i>	V	-	No	No	All zones
spotted harrier <i>Circus assimilis</i>	V	-	No	No	-
brown treecreeper (eastern subspecies) <i>Climacteris picumnus victoriae</i>	V	-	No	No	All zones
oriental cuckoo <i>Cuculus optatus</i>	-	C, J, K	No	No	-
varied sittella <i>Daphoenositta chrysoptera</i>	V	-	No	No	All zones
spotted-tailed quoll <i>Dasyurus maculatus</i>	V	E	No	No	All zones

Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
grey falcon <i>Falco hypoleucos</i>	E	V	No	No	-
black falcon <i>Falco subniger</i>	V	-	No	No	-
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	No	No	-
little lorikeet <i>Glossopsitta pusilla</i>	V	-	No	No	All zones
painted honeyeater <i>Grantiella picta</i>	V	V	No	No	All zones
white-bellied sea-eagle <i>Haliaeetus leucogaster</i>	V	-	No	No	All zones
little eagle <i>Hieraetus morphnoides</i>	V	-	No	No	All zones
barn swallow <i>Hirundo rustica</i>	-	C, J, K	No	No	-
swift parrot <i>Lathamus discolor</i>	E	CE	No	No	All zones
square-tailed kite <i>Lophoictinia isura</i>	V	-	No	No	All zones
hooded robin (south-eastern form) <i>Melanodryas cucullata</i>	V	-	No	No	-
eastern coastal free-tailed bat <i>Micronomus norfolkensis</i>	V	-	No	No	All zones
little bent-winged bat <i>Miniopterus australis</i>	V	-	No	No	All zones

Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
large bent-winged bat <i>Miniopterus orianae oceanensis</i>	V	-	No	No	All zones
yellow wagtail <i>Motacilla flava</i>	-	C, J, K	No	No	-
turquoise parrot <i>Neophema pulchella</i>	V	-	No	No	All zones
powerful owl <i>Ninox strenua</i>	V	-	No	No	All zones
eastern osprey <i>Pandion cristatus</i>	V	-	No	No	VZ2
scarlet robin <i>Petroica boodang</i>	V	-	No	No	All zones
koala <i>Phascolarctos cinereus</i>	V	V	No	No	All zones
golden-tipped bat <i>Phoniscus papuensis</i>	V	-	No	No	All zones
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis</i>	V	-	No	No	All zones
New Holland mouse <i>Pseudomys novaehollandiae</i>	-	V	No	No	-
grey-headed flying-fox <i>Pteropus poliocephalus</i>	V	V	No	No	All zones
Wompoo fruit-dove <i>Ptilinopus magnificus</i>	V	-	No	No	-
rose-crowned fruit-dove <i>Ptilinopus regina</i>	V	-	No	No	-

Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
superb fruit-dove <i>Ptilinopus superbus</i>	V	-	No	No	-
yellow-bellied sheath-tail-bat <i>Saccolaimus flaviventris</i>	V	-	No	No	All zones
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V	-	No	No	-
diamond firetail <i>Stagonopleura guttata</i>	V	-	No	No	VZ1, VZ3
eastern grass owl <i>Tyto longimembris</i>	V	-	No	No	-
masked owl <i>Tyto novaehollandiae</i>	V	-	No	No	All zones

C= CAMBA, J=JAMBA, R=ROKAMBA



## APPENDIX E

### Species-credit Species Survey Methods

**Table E-1 Species-credit Species Survey Methods**

**Table E-1** identifies the candidate species-credit species predicted by the BAM calculator or identified in the literature review, and documents the surveys undertaken within the Development Footprint for each species. Marine, pelagic and wetland fauna species have been excluded due to lack of suitable habitat in the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>Flora Species</b>							
<b>Bynoe's wattle</b> <i>Acacia bynoeana</i>	E	V	All year	-	BAM-C	-	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>Charmhaven apple</b> <i>Angophora inopina</i>	V	V	All year	-	BioNetAtlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>thick-leaf star-hair</b> <i>Astrotricha crassifolia</i>	V	V	Jul-Dec	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>thick lip spider orchid</b> <i>Caladenia tessellata</i>	E	V	Sept-Oct	-	PMST, BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>netted bottle brush</b> <i>Callistemon linearifolius</i>	V	-	Oct- Jan	-	BioNet Atlas, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in October and December 2019 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>dwarf kerrawang</b> <i>Commersonia prostrata</i>	E	E	All year	-	PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<i>Corunastylis</i> sp. <b>Charmhaven</b> (NSW896673)	CE	CE	Nov-April	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019, and March 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>leafless tongue-orchid</b> <i>Cryptostylis hunteriana</i>	V	V	Nov-Jan	-	PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>white-flowered wax plant</b> <i>Cynanchum elegans</i>	E	E	All year	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<i>Diuris bracteata</i>	E	Ex	Aug-Sept	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September 2019, and August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>Rough Doubletail</b> <i>Diuris praecox</i>	V	V	Aug	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in August 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>Camfield's stringybark</b> <i>Eucalyptus camfieldii</i>	V	V	All year	-	PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<i>Eucalyptus camaldulensis</i> population in the Hunter catchment <i>Eucalyptus camaldulensis</i>	EP	-	All year	Floodplains of watercourses, including rivers, creeks, intermittent streams, or billabongs.	BioNet Atlas	No	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required
<b>slaty red gum</b> <i>Eucalyptus glaucina</i>	V	V	All year	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>Earp's gum</b> <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	V	All year	-	PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<i>Euphrasia arguta</i>	CE	CE	Nov-March	-	BioNet Atlas, PMST	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019, and March 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>variable midge orchid</b> <i>Genoplesium insigne</i>	CE	CE	Sept-Nov	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>small-flower grevillea</b> <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V	V	Aug- Nov	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and August and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<i>Grevillea shiressii</i>	V	V	Jul- Dec	-	BioNet Atlas, PMST	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and August and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b><i>Maundia triglochinos</i></b>	V	-	Nov-March	Riparian areas/drainage lines, water ponding, man-made dams, and drainage channels up to 1 m deep.	BioNet Atlas	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019, and March 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>biconvex paperbark <i>Melaleuca biconvexa</i></b>	V	V	All year	-	BioNet Atlas, PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>Grove's paperbark <i>Melaleuca groveana</i></b>	V	-	All year	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>scrambling lignum <i>Muehlenbeckia costata</i></b>	V	-	All year	Rocky areas or within 50m or rocky areas.	BioNet Atlas	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>knotweed <i>Persicaria elatior</i></b>	V	V	Dec-May	Semi-permanent/ephemeral wet areas, swamps, wetlands, or waterbodies, or within 50 m.	PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019, and March 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
lesser swamp-orchid <i>Prasophyllum</i> sp. <i>Wybong</i>	-	CE	Sept-Oct	-	PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
tranquillity mintbush <i>Prostanthera askania</i>	E	E	Sept-Nov	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
Somersby mintbush <i>Prostanthera junonis</i>	E	E	Oct-Dec	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in October and December 2019 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
Illawarra greenhood <i>Pterostylis gibbosa</i>	E	E	Sept-Oct	-	PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
coast headland pea <i>Pultenaea maritima</i>	V	-	All year	-	BioNet Atlas	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
eastern underground orchid <i>Rhizanthella slateri</i>	V	E	Sept-Nov	-	PMST	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
scrub turpentine <i>Rhodamnia rubescens</i>	CE	-	All year	-	BioNet Atlas	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
native guava <i>Rhodomyrtus psidioides</i>	CE	-	All year	-	BioNet Atlas	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
heath wrinklewort <i>Rutidosis heterogama</i>	V	V	All year	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
rainforest cassia <i>Senna acclinis</i>	E	-	All year	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>magenta lilly pilly</b> <i>Syzygium paniculatum</i>	E	V	April-June	-	BioNet Atlas, PMST	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods for this highly detectable species.
<b>Tetratheca glandulosa</b>	V	-	Aug-Nov	-	BioNet Atlas, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and August, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>black-eyed Susan</b> <i>Tetratheca juncea</i>	V	V	Sep-Oct	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to <b>Figure 4.1</b> ). Opportunistic observations were completed throughout all Umwelt survey periods.
<b>Zannichellia palustris</b>	E	-	Oct-Jan	Freshwater or slightly brackish estuarine areas (10%).	BioNet Atlas	No	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required
<b>Fauna Species</b>							
<b>regent honeyeater</b> <i>Anthochaera phrygia</i>	CE	CE	N/A	Important habitat only (as defined by mapping products supplied by the BCD).	BioNet Atlas, PMST, BAM-C	Yes	Surveys are not required for this species under the BAM as it is not mapped as important habitat within the Development Footprint. As such, it is assessed as an ecosystem credit species.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>bush stone-curlew</b> <i>Burhinus grallarius</i>	E	-	All year	Fallen/standing dead timber including logs.	BioNet Atlas, BAM-C	No	<p>A total of 95km of walking transects were completed across the Study Area.</p> <p>Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>In addition, opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>glossy black-cockatoo</b> <i>Calyptorhynchus lathami</i>	V	-	Mar-Aug	<p>Breeding habitat only.</p> <p>Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.</p>	BioNet Atlas, BAM-C	No	<p>Targeted diurnal surveys were completed in August 2020 during flora transects. The Development Footprint was walked across two days searching for this species and potential breeding behaviour.</p> <p>Opportunistic observations were also completed throughout all Umwelt survey periods.</p>
<b>gang-gang cockatoo</b> <i>Callocephalon fimbriatum</i>	V	-	Oct-Jan	<p>Breeding habitat only.</p> <p>Eucalypt tree species with hollows greater than 9 cm diameter.</p>	BioNet Atlas, BAM-C	No	<p>Targeted diurnal surveys were completed in October and December 2019 and January and October 2020 during flora transects. The Development Footprint was walked across six days and searching for this species and potential breeding behaviour.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>eastern pygmy-possum</b> <i>Cercartetus nanus</i>	V	-	Oct-Mar	-	BioNet Atlas, BAM-C	No	<p>Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b>) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species.</p> <p>Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>large-eared pied bat</b> <i>Chalinolobus dwyeri</i>	V	V	Nov-Jan	Breeding habitat only. Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	BioNet Atlas, PMST	Yes	<p>As per the Species credit threatened bat NSW Survey Guideline ( OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only.</p> <p>While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in <b>Figure 3.1</b>, extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and ecologists with more than 10 years experience.</p> <p>As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>Wallum froglet</b> <i>Crinia tinnula</i>	V	-	All year	-	BioNet Atlas, BAM-C	No	No permanent water or paperbark swamps were identified within the Study Area. Two ephemeral first order streams and one stormwater detention basin were identified and surveyed. Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in September 2019, and January and February 2020 (refer to <b>Figure 4.1</b> ). Auditory surveys of 15 minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>red goshawk</b> <i>Erythrotriorchis radiatus</i>	CE	V	All year	-	PMST	Yes	This species is considered a vagrant and not subjected to any targeted survey effort.
<b>white-bellied sea-eagle</b> <i>Haliaeetus leucogaster</i>	V	-	Jul-Dec	Breeding habitat only. Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands, and coastlines.	BioNet Atlas, BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>giant burrowing frog</b> <i>Heleioporus australiacus</i>	V	V	Sept-May	Hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features.	PMST	No	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>little eagle</b> <i>Hieraaetus morphnoides</i>	V	-	Aug-Oct	Breeding habitat only. Nest trees - live (occasionally dead) large old trees within vegetation.	BioNet Atlas, BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>white-throated needletail</b> <i>Hirundapus caudacutus</i>	-	V	N/A	-	BioNet Atlas, PMST	N/A	Opportunistic observations were completed during the extensive walking surveys completed.
<b>pale-headed snake</b> <i>Hoplocephalus bitorquatus</i>	V	-	Nov-March	-	BAM-C	No	<p>Whilst the pale-headed snake cannot be considered a vagrant as records exist in the Wyong IBRA subregion, records in the lower Hunter Valley are very scarce and old.</p> <p>Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b>) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>swift parrot</b> <i>Lathamus discolor</i>	E	CE	N/A	Important habitat only (as defined by mapping products supplied by the BCD)	BioNet Atlas, PMST, BAM-C	Yes	Surveys are not required for this species under the BAM as it is not mapped as important habitat within the Development Footprint. As such, it is assessed as an ecosystem credit species.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>green and golden bell frog</b> <i>Litoria aurea</i>	E	V	Nov-Mar	Semi-permanent/ephemeral wet areas and within 1km of swamps and waterbodies.	BioNet Atlas, PMST, BAM-C	No	<p>Targeted nocturnal call playback surveys were undertaken across the Development Footprint in three locations in January and February 2020 following rainfall (refer to <b>Figure 4.1</b>). These sessions began with a period of quiet listening for approximately 5 minutes. <i>Litoria aurea</i> calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.</p> <p>Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of 6 person hours of survey were conducted across the Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>green-thighed frog</b> <i>Litoria brevipalmata</i>	V	-	Oct-March	-	BAM-C	No	<p>Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in September 2019, and January and February 2020 (refer to <b>Figure 4.1</b>). Auditory surveys of 15 minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
<b>Littlejohn's tree frog</b> <i>Litoria littlejohni</i>	V	V	Jul-Nov	-	PMST	No	Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in September 2019, and January and February 2020 (refer to <b>Figure 4.1</b> ). Auditory surveys of 15 minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>square-tailed kite</b> <i>Lophoictinia isura</i>	V	-	Sept-Jan	Breeding habitat only. Nest trees.	BioNet Atlas, BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>little bent-winged bat</b> <i>Miniopterus australis</i>	V	-	Dec-Feb	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	BioNet Atlas	Yes	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in <b>Figure 3.1</b> , extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and ecologists with more than 10 years experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. . No breeding habitat for this species was recorded in nearby areas during the Rankin Park to Jesmond Bypass project (GHD 2018) and there are no documented breeding sites nearby on any threatened species databases. As such, no further surveys were completed.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
<b>large bentwing-bat</b> <i>Miniopterus orianae oceanensis</i>	V	-	Dec-Feb	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	BioNet Atlas	Yes	<p>As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only.</p> <p>While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in <b>Figure 3.1</b>, extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and ecologists with more than 10 years experience.</p> <p>As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.</p> <p>No breeding habitat for this species was recorded in nearby areas during the Rankin Park to Jesmond Bypass project (GHD 2018) and there are no documented breeding sites nearby on any threatened species databases. As such, no further surveys were completed.</p>
<b>stuttering frog</b> <i>Mixophyes balbus</i>	E	V	Sept-Mar	-	PMST	Yes	<p>No flowing or permanent streams are present in the Development Footprint and as such the habitat is considered too degraded for this species.</p>
<b>southern myotis</b> <i>Myotis macropus</i>	V	-	Oct-Mar	Breeding habitat only. Hollow bearing trees within 200 m of riparian zone. Bridges, caves, or artificial structures within 200 m of riparian zone.	BioNet Atlas, BAM-C	No	<p>This species occurs adjacent to large permanent waterbodies. No breeding habitat was observed within the Development Footprint during the extensive walking surveys. No breeding habitat for this species was recorded in nearby areas during the Rankin Park to Jesmond Bypass project (GHD 2018) and there are no documented breeding sites nearby on any threatened species databases. As such, no further surveys were completed.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>barking owl</b> <i>Ninox connivens</i>	V	-	May-Dec	Breeding habitat only. Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	BioNet Atlas	No	<p>Potential breeding habitat (as defined by the TBDC) was observed within the Development Footprint during the extensive walking surveys. As per the BAM, breeding habitat is defined by the presence of potential habitat <u>and</u> evidence of breeding (observation or duetting). As potential breeding habitat was identified, stag watches and call playback were undertaken at 16 locations within the Study Area in September 2019 and August 2020. This involved watching the hollows of potential breeding habitat at dusk for emergence of fauna followed by the broadcasting of owl calls.</p> <p>These sessions began with a period of quiet listening for approximately 5 minutes. Barking owl calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.</p> <p>Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the Study Area.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods and no secondary signs of presence or breeding (whitewash or prey carcasses) were identified during any of the survey periods. This coverage was considered appropriate both in terms of timing and spatial extent to ensure that should breeding activities be occurring within the potential habitat on site that this would have been recorded either through observations or heard.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
powerful owl <i>Ninox strenua</i>	V	-	May-Aug	Breeding habitat only. Living or dead trees with hollow greater than 20cm diameter.	BioNet Atlas, BAM-C	No	<p>Potential breeding habitat (as defined by the TBDC) was observed within the Development Footprint during the extensive walking surveys. As per the BAM, breeding habitat is defined by the presence of potential habitat <u>and</u> evidence of breeding (observation or duetting). As potential breeding habitat was identified, stag watches and call playback were undertaken at 16 locations within the Study Area in September 2019 and August 2020. This involved watching the hollows of potential breeding habitat at dusk for emergence of fauna followed by the broadcasting of owl calls.</p> <p>These sessions began with a period of quiet listening for approximately 5 minutes. Powerful owl calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.</p> <p>Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the Study Area.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods and no secondary signs of presence or breeding (whitewash or prey carcasses) were identified during any of the survey periods. This coverage was considered appropriate both in terms of timing and spatial extent to ensure that should breeding activities be occurring within the potential habitat on site that this would have been recorded either through observations or heard.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>eastern osprey <i>Pandion cristatus</i></b>	V	-	April-Nov	Breeding habitat only. Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting.	BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Extensive searches completed across the broader study area on foot (refer to <b>Figure 4.1</b> ) failed to identify any large stick nest that could be attributed to the eastern osprey or any other large raptor species. As no breeding habitat is present, no additional surveys were required. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>greater glider <i>Petauroides volans</i></b>	-	V	All year	Hollow-bearing trees.	BioNet Atlas, PMST	No	Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b> ) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>squirrel glider</b> <i>Petaurus norfolcensis</i>	V	-	All year	-	BioNet Atlas, BAM-C	No	<p>Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b>) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species.</p> <p>Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>brush-tailed rock-wallaby</b> <i>Petrogale penicillata</i>	E	V	All year	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	PMST	Yes	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>brush-tailed phascogale</b> <i>tapoatafa</i>	V	-	Dec-June	-	BAM-C	No	<p>Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b>) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species.</p> <p>Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

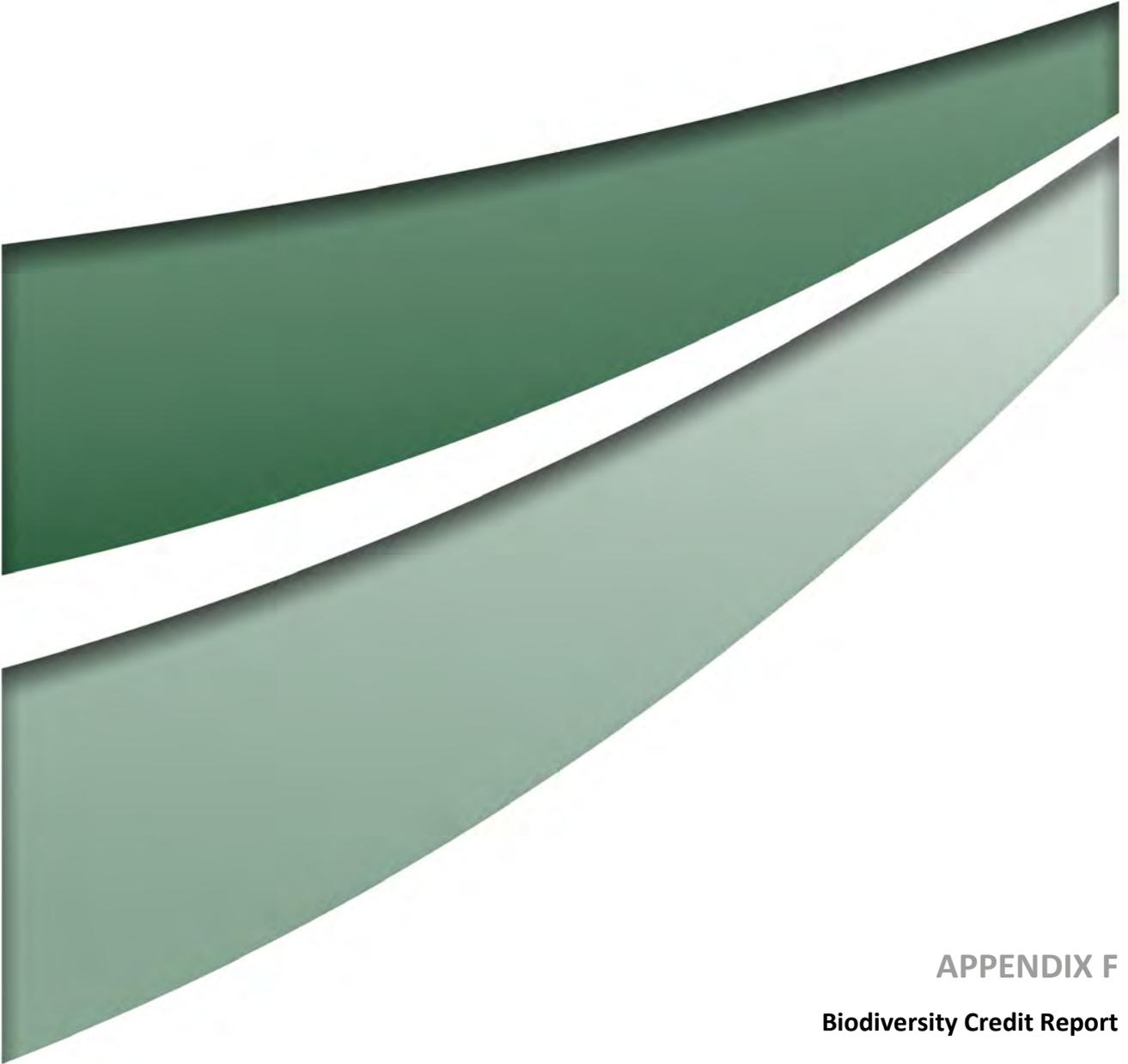
Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>koala</b> <i>Phascolarctos cinereus</i>	V	V	All year	Important habitat only (as defined by mapping products supplied by the BCD).	BioNet Atlas, PMST	No	<p>The Development Footprint is not located in an area of important habitat and defined by BCD as it contained a very low density of koala feed trees.</p> <p>Assessment using the Koala Spot Assessment was completed at the four floristic plot location (refer to <b>Figure 3.1</b>)</p> <p>Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b>) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species.</p> <p>Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>common planigale</b> <i>maculata</i>	V	-	All year	-	BAM-C	No	<p>Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to <b>Figure 4.1</b>) for between 15-30 minutes, and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species.</p> <p>Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>long-nosed potoroo</b> <i>Potorous tridactylus</i>	V	V	All year	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).	PMST	No	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required
<b>red-crowned toadlet</b> <i>Pseudophryne australis</i>	V	-	All year	-	BAM-C	No	The species-specific habitat is not present within the Development Footprint. As such the habitat onsite is considered too degraded for this species.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>grey-headed flying-fox</b> <i>Pteropus poliocephalus</i>	V	V	Oct-Dec	Breeding camps.	BioNet Atlas, PMST	No	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required
<b>golden sun moth</b> <i>Synemon plana</i>	E	CE	Oct-Dec	Wallaby grass ( <i>Rytidosperma</i> sp.), Chilean needlegrass ( <i>Nassella nessiana</i> ) or serrated tussock ( <i>Nassella trichotoma</i> )	PMST	Yes	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required
<b>red-backed button-quail</b> <i>Turnix maculosus</i>	V	-	All year	-	BAM-C	No	A total of 95km of walking transects were completed across the Study Area. Opportunistic observations were completed throughout all Umwelt survey periods.
<b>masked owl</b> <i>Tyto novaehollandiae</i>	V	-	May-Aug	Breeding habitat only. Living or dead trees with hollows greater than 20cm diameter.	BioNet Atlas, BAM-C	No	Stag watches and call playback were undertaken at 16 locations within the Study Area in September 2019 and August 2020. This involved watching the hollows of potential breeding trees at dusk for emergence of fauna followed by the broadcasting of owl calls. These sessions began with a period of quiet listening for approximately 5 minutes. Masked owl calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the Study Area. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>sooty owl</b> <i>Tyto tenebricosa</i>	V	-	April-Aug	Breeding habitat only. Caves or clifflines/ledges. Living or dead trees with hollows greater than 20cm diameter.	BioNet Atlas	Yes	<p>Stag watches and call playback were undertaken at 16 locations within the Study Area in September 2019 and August 2020. This involved watching the hollows of potential breeding trees at dusk for emergence of fauna followed by the broadcasting of owl calls.</p> <p>These sessions began with a period of quiet listening for approximately 5 minutes. Sooty owl calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.</p> <p>Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the Study Area.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
<b>Mahony's toadlet</b> <i>Uperoleia mahonyi</i>	E	-	Oct-March	-	BAM-C	No	<p>Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in September 2019, and January and February 2020 (refer to <b>Figure 4.1</b>). Auditory surveys of 15 minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAIL Entity	Survey Method
<b>eastern cave bat</b> <i>Vespadelus troughtoni</i>	V	-	Nov-Jan	Breeding habitat only. Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices, or boulder piles, or within two kilometres of old mines, tunnels, old buildings, or sheds.	BioNet Atlas	Yes	<p>As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. Potential habitat for this species is defined as rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat.</p> <p>While the Development Footprint may contain foraging habitat for this species, no rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds are present or , based on API, located within 100m of the Development Footprint. As shown in <b>Figure 4.1</b>, extensive walking transects have been completed across the Development Footprint and wider Study Area by accredited assessors and an ecologist with more than 10 years experience.</p> <p>As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.</p> <p>. No breeding habitat for this species was recorded in nearby areas during the Rankin Park to Jesmond Bypass project (GHD 2018) and there are no documented breeding sites nearby on any threatened species databases. As such, no further surveys were completed.</p>



**APPENDIX F**  
**Biodiversity Credit Report**



# BAM Biodiversity Credit Report (Like for like)

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct	10/06/2021
Assessor Name	Assessor Number	BAM Data version *
		45
Proponent Names	Report Created	BAM Case Status
Shaun Corry	16/08/2021	Open
Assessment Revision	Assessment Type	Date Finalised
4	Major Projects	To be finalised

\* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
<b>Nil</b>		
Species		
<b>Nil</b>		

## Additional Information for Approval

PCTs With Customized Benchmarks

Assessment Id

00017871/BAAS18117/19/00017872

Proposal Name

John Hunter Health Innovation Precinct



# BAM Biodiversity Credit Report (Like for like)

PCT

No Changes

Predicted Threatened Species Not On Site

Name

**Grantiella picta** / Painted Honeyeater

**Haliaeetus leucogaster** / White-bellied Sea-Eagle

## Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Not a TEC	1.7	35	0	35
1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not a TEC	0.7	13	0	13

1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region



## BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_Mod_Good	Yes		13 Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
<b>1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast</b>	<b>Like-for-like credit retirement options</b>					
	Class	Trading group	Zone	HBT	Credits	IBRA region

## BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1627_Mod_Good	Yes	35	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
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### Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
<b>Petaurus norfolcensis</b> / Squirrel Glider	<b>1592_Mod_Good, 1619_Mod_Good, 1627_Mod_Good</b>	4.7	132.00
<b>Tetratheca juncea</b> / Black-eyed Susan	<b>1592_Mod_Good, 1619_Mod_Good</b>	0.4	11.00

### Credit Retirement Options

Like-for-like credit retirement options

## BAM Biodiversity Credit Report (Like for like)

<b>Petaurus norfolcensis</b> / Squirrel Glider	Spp	IBRA subregion
	<b>Petaurus norfolcensis</b> / Squirrel Glider	Any in NSW
<b>Tetratheca juncea</b> / Black-eyed Susan	Spp	IBRA subregion
	<b>Tetratheca juncea</b> / Black-eyed Susan	Any in NSW

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct	10/06/2021
Assessor Name	Report Created	BAM Data version *
	16/08/2021	45
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
4	Major Projects	

\* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
<b>Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands</b>											
3	1619_Mod_Good	Not a TEC	48	48.0	0.7			High Sensitivity to Potential Gain	1.50		13
										<b>Subtotal</b>	<b>13</b>

Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast										
2	1627_Mod_Good	Not a TEC	54.4	54.4	1.7			High Sensitivity to Potential Gain	1.50	35
									<b>Subtotal</b>	<b>35</b>
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter										
1	1592_Mod_Good	Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	59.8	59.8	2.3	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00	69
									<b>Subtotal</b>	<b>69</b>
									<b>Total</b>	<b>117</b>

## Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAI	Species credits	
<b><i>Petaurus norfolcensis / Squirrel Glider ( Fauna )</i></b>									
1592_Mod_Good	59.8	59.8	2.3	Vulnerable	Not Listed	2	False	69	
1619_Mod_Good	48.0	48.0	0.7	Vulnerable	Not Listed	2	False	17	
1627_Mod_Good	54.4	54.4	1.7	Vulnerable	Not Listed	2	False	46	
								<b>Subtotal</b>	<b>132</b>
<b><i>Tetratheca juncea / Black-eyed Susan ( Flora )</i></b>									
1592_Mod_Good	59.8	59.8	0.04	Vulnerable	Vulnerable	2	False	1	
1619_Mod_Good	48.0	48.0	0.4	Vulnerable	Vulnerable	2	False	10	
								<b>Subtotal</b>	<b>11</b>





# BAM Biodiversity Credit Report (Like for like)

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct - Phase 1	10/06/2021
Assessor Name	Assessor Number	BAM Data version *
		45
Proponent Names	Report Created	BAM Case Status
Shaun Corry	19/08/2021	Open
Assessment Revision	Assessment Type	Date Finalised
5	Major Projects	To be finalised

\* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
<b>Nil</b>		
Species		
<b>Nil</b>		

## Additional Information for Approval

PCTs With Customized Benchmarks

Assessment Id	Proposal Name
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct - Phase 1



# BAM Biodiversity Credit Report (Like for like)

PCT

No Changes

Predicted Threatened Species Not On Site

Name

**Grantiella picta** / Painted Honeyeater

**Haliaeetus leucogaster** / White-bellied Sea-Eagle

## Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Not a TEC	0.9	19	0	19
1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not a TEC	0.7	13	0	13

1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region



## BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_Mod_Good	Yes		13 Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
<b>1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast</b>	<b>Like-for-like credit retirement options</b>					
	Class	Trading group	Zone	HBT	Credits	IBRA region

## BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1627_Mod_Good	Yes	19	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

### Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
<b>Petaurus norfolcensis</b> / Squirrel Glider	<b>1592_Mod_Good, 1619_Mod_Good, 1627_Mod_Good</b>	3.9	111.00
<b>Tetratheca juncea</b> / Black-eyed Susan	<b>1592_Mod_Good, 1619_Mod_Good</b>	0.4	11.00

### Credit Retirement Options

Like-for-like credit retirement options

## BAM Biodiversity Credit Report (Like for like)

<b>Petaurus norfolcensis</b> / Squirrel Glider	Spp	IBRA subregion
	<b>Petaurus norfolcensis</b> / Squirrel Glider	Any in NSW
<b>Tetratheca juncea</b> / Black-eyed Susan	Spp	IBRA subregion
	<b>Tetratheca juncea</b> / Black-eyed Susan	Any in NSW

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct - Phase 1	10/06/2021
Assessor Name	Report Created	BAM Data version *
	19/08/2021	45
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
5	Major Projects	

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## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
<b>Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands</b>											
3	1619_Mod_Good	Not a TEC	48	48.0	0.7			High Sensitivity to Potential Gain	1.50		13
										<b>Subtotal</b>	<b>13</b>

Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast										
2	1627_Mod_Good	Not a TEC	54.4	54.4	0.91			High Sensitivity to Potential Gain	1.50	19
									<b>Subtotal</b>	<b>19</b>
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter										
1	1592_Mod_Good	Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	59.8	59.8	2.3	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00	69
									<b>Subtotal</b>	<b>69</b>
									<b>Total</b>	<b>101</b>

## Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAll	Species credits	
<b><i>Petaurus norfolcensis</i> / Squirrel Glider ( Fauna )</b>									
1592_Mod_Good	59.8	59.8	2.3	Vulnerable	Not Listed	2	False	69	
1619_Mod_Good	48.0	48.0	0.7	Vulnerable	Not Listed	2	False	17	
1627_Mod_Good	54.4	54.4	0.91	Vulnerable	Not Listed	2	False	25	
								<b>Subtotal</b>	<b>111</b>
<b><i>Tetratheca juncea</i> / Black-eyed Susan ( Flora )</b>									
1592_Mod_Good	59.8	59.8	0.04	Vulnerable	Vulnerable	2	False	1	
1619_Mod_Good	48.0	48.0	0.4	Vulnerable	Vulnerable	2	False	10	
								<b>Subtotal</b>	<b>11</b>





# BAM Biodiversity Credit Report (Like for like)

## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct - Phase 2	10/06/2021
Assessor Name	Assessor Number	BAM Data version *
		45
Proponent Names	Report Created	BAM Case Status
Shaun Corry	19/08/2021	Open
Assessment Revision	Assessment Type	Date Finalised
6	Major Projects	To be finalised

\* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
<b>Nil</b>		
Species		
<b>Nil</b>		

## Additional Information for Approval

PCTs With Customized Benchmarks

Assessment Id	Proposal Name
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct - Phase 2



## BAM Biodiversity Credit Report (Like for like)

PCT

No Changes

Predicted Threatened Species Not On Site

Name

**Grantiella picta** / Painted Honeyeater

**Haliaeetus leucogaster** / White-bellied Sea-Eagle

### Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Not a TEC	0.8	16	0	16



## BAM Biodiversity Credit Report (Like for like)

<b>1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast</b>	<b>Like-for-like credit retirement options</b>					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1627_Mod_Good	Yes	16	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

### Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
<b>Petaurus norfolcensis</b> / Squirrel Glider	<b>1627_Mod_Good</b>	0.8	21.00

### Credit Retirement Options

Like-for-like credit retirement options

Petaurus norfolcensis / Squirrel Glider	Spp	IBRA subregion



## BAM Biodiversity Credit Report (Like for like)

	<b>Petaurus norfolcensis</b> / Squirrel Glider	Any in NSW
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## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017871/BAAS18117/19/00017872	John Hunter Health Innovation Precinct - Phase 2	10/06/2021
Assessor Name	Report Created	BAM Data version *
	19/08/2021	45
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
6	Major Projects	

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## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
<b>Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast</b>											
1	1627_Mod_Good	Not a TEC	54.4	54.4	0.79			High Sensitivity to Potential Gain	1.50		16
										<b>Subtotal</b>	<b>16</b>
										<b>Total</b>	<b>16</b>

## Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAll	Species credits
<b><i>Petaurus norfolcensis / Squirrel Glider ( Fauna )</i></b>								
1627_Mod_Good	54.4	54.4	0.79	Vulnerable	Not Listed	2	False	21
							<b>Subtotal</b>	<b>21</b>

